

HIGH TECHNOLOGY BUSINESS

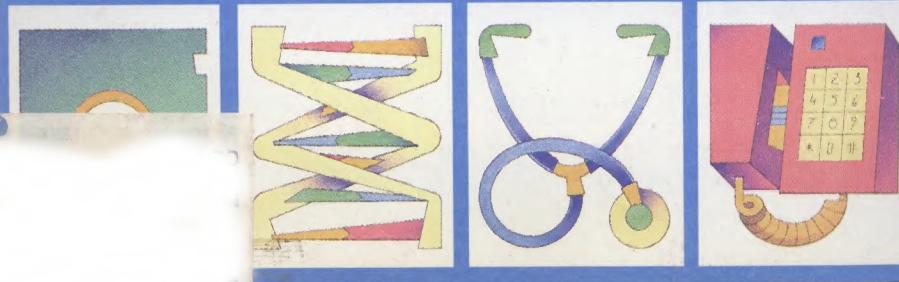
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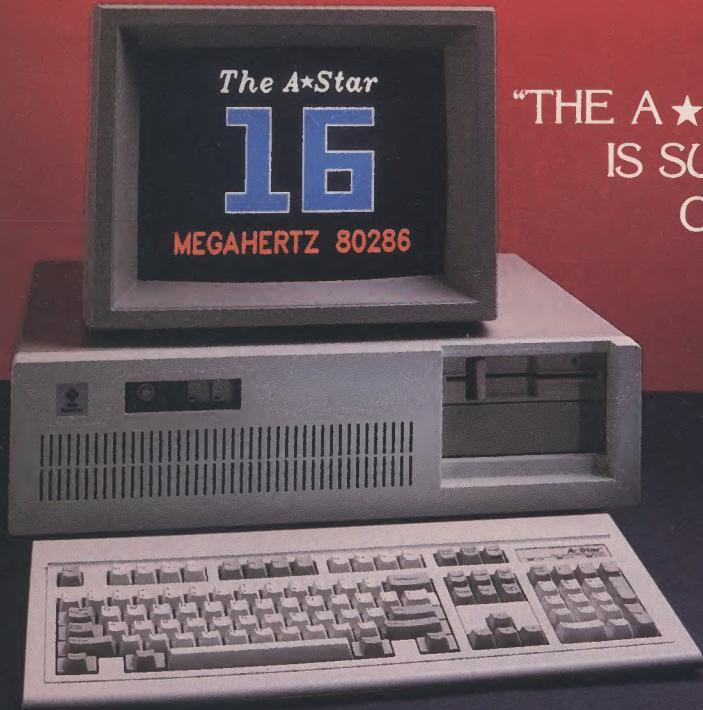
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SCIENCE/SCOPE®

Aided by a tiny, heat-sensitive microchip "sandwich", astronomers are experiencing a quantum leap forward in infrared astronomy. The Hughes Aircraft Company-built detector device is placed in a camera-like system and attached to the bottom of an infrared telescope. Called an infrared focal plane array, the device contains nearly 4,000 detectors which sense the radiant heat energy emitted from heavenly bodies and turn it into clear, sharp images in record time. Astronomers will be able to use the array to study the planets in our solar system, the center of the galaxy, and millions of other galaxies in greater detail than ever before. The array was first used in the United Kingdom Infrared Telescope (UKIRT) in Hawaii.

Using advanced robotics and Artificial Intelligence (AI) technologies, a U.S. Army scout car was computer-driven from a remotely located command post over a mile away. During the first-of-its-kind demonstration, the Advanced Ground Vehicle Technology program, sponsored by the Defense Advanced Research Projects Agency and the U.S. Army's Tank-Automotive Command, utilized three Hughes-built systems. The Autonomous Vision System transmitted video images of the road to computers which sent back steering, brake, and throttle commands. The AI-based Map And Planning System kept track of the vehicle at all times and displayed its location and a map of the local area on a color monitor. The system was operated day and night with Hughes thermal sensors and a complex communication link which coordinated the overall system function.

Hughes quality inspectors are using a voice input system on the production line to significantly reduce time and cost during the inspection of advanced radar modules. A major advance in speech-recognition technology, the Hughes-built system combines computers and artificial intelligence techniques with software programming designed by Hughes. The computers, with a vocabulary of up to 1,000 words, give verbal instructions, repeat the inspector's words for verification using a built-in voice synthesis feature, and then record the information. Introduced on the APG-65 radar production line, additional voice input systems are being installed on other radar production lines.

Advanced V-band circuitry will play a key role in satellite-to-satellite communications and in the operation of spaceborne imaging array systems. Hughes is developing for the U.S. Air Force compact, reproducible, reliable transmit/receive switches and analog and digital phase shifters. The components will operate at approximately 60 GHz, the preferred range for phased array equipment in future space systems. The V-band includes frequencies from 50 to 70 GHz, and is considered the optimum frequency range for orbiting secure communications systems.

Support Systems in Southern California designs, develops, and manufactures some of the most sophisticated training simulators and a wide array of automatic and manual test systems. In addition, field engineering and technical support of a wide range of electronic systems keep Hughes' systems operating at top efficiency worldwide. Opportunities are available for a variety of engineers qualified by degree or extensive work experience. They include systems engineers, radar engineers, and software and hardware design engineers. Please send your resume to Lowell Anderson, Professional Employment, Dept. S2, Hughes Aircraft Company, P.O. Box 9399, Long Beach, CA 90801-0463. Equal opportunity employer, U.S. citizenship required.

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HIGH TECHNOLOGY BUSINESS

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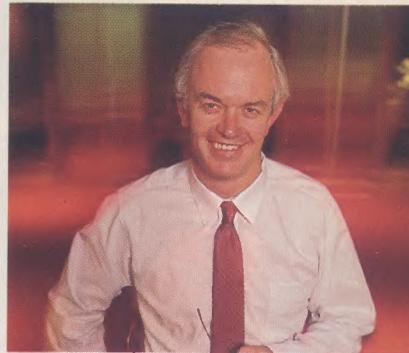
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PERSONAL TECHNOLOGY Reference books on CD-ROM; data access on the go; electronic greeting cards.



Venture capital looks to the future, p. 18.



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Cover illustration by Mark Fisher

Back By Popular Demand.

At one time, peregrine falcons nested by the thousands throughout the United States. But with the widespread use of the insecticide DDT in the 1940s and 1950s, the species suffered greatly. In the eastern U.S., the peregrine falcon disappeared entirely.

Now peregrine falcons have made a comeback, thanks to efforts by conservationists.

Since 1975 when recovery programs were established, 752 peregrines have been released in the eastern U.S., and there has been a steady increase in the nesting population.

With wise conservation policies, other once rare species such as the American alligator and the bald eagle have also made comebacks.

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Venture Capital Speaks Out

OVER THE LAST decade, venture-capital firms have become a significant factor shaping the future of technology. Their decisions about which companies and industries deserve funding help determine which technological breakthroughs will be developed and commercialized.

But back in September, when HIGH TECHNOLOGY BUSINESS began planning the survey of venture-capital companies that appears on page 21, we didn't anticipate that the events of late 1987 would make the results of our survey even more significant.

Assistant managing editor Fredric Paul oversaw the survey and wrote the story, based on both the results and on independent interviews with leading venture-capital firms. In the wake of the chaos that followed October 19, he found some skepticism about capital-intensive fields such as computer hardware. Venture capitalists also stressed that the timing of an investment is even more critical now than under normal circumstances.

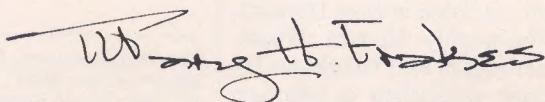
However, the survey, which drew more than 200 responses, reflected little sense of panic. Most firms say their level of investment in technology companies will remain constant, and the number that say they plan to increase such investments is four times the number that plan to cut back.

In fact, many venture capitalists interviewed said a chastened market might not be so bad if it shakes out the less well-managed companies. "With the inordinate profits earned from 1980 to 1983, people came into the venture-capital business like bugs to a light," said one. "But they found out it takes work, it takes a certain amount of will, and it takes dedication."

This issue also includes the story "Fax Makers Target Low-End Market" (p. 26), which shows why facsimile machines are barely profitable for their makers even though sales—particularly sales to smaller businesses—are exploding. In addition, the story indicates that overnight-delivery services may have to change their strategies, because companies are finding it increasingly cost-effective to buy fax equipment.

This is the kind of information we know business people need. Information about the technology their companies should buy and use to stay competitive. Information about developing technology that will affect a variety of industries. Information that lets them profit from knowing which companies are most successful at what they do—and why.

It's the kind of information we'll continue to provide.



Mary H. Frakes

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**HIGH TECHNOLOGY
BUSINESS**

■ Mr. Xerox

IN THE DECEMBER interview with Xerox president Paul Allaire, Xerox is called "Carlson's company," referring to Chester Carlson. But if anyone is responsible for the growth and spread of Xerox, the credit should go to Joseph C. Wilson, "Mr. Xerox," and next to Dr. John H. Dessauer.

Without them there would have been no Xerox. Carlson contacted many other companies before Haloid agreed to try and develop his process for making photocopies. I worked for Haloid, Haloid Xerox, and finally Xerox for 32 years and saw it all evolve. Joe Wilson was the most charismatic person I have ever known—a true entrepreneur at a time when most had never heard the word. There wasn't a marketing expert or banker that didn't say he was nuts. But then, marketing experts and bankers only believe in things after they have been proven and are making money, lots of money. I had some stock in the company and for years it never paid a dividend over 2 percent.

John L. Kneeland
Pulteney, New York

■ Computer Support is Crucial

IN HIS NOVEMBER column, "Office 'Standards' Relax," Andrew M. Seybold neglected a key issue: *support*. His argument is probably quite valid for small companies, but the larger corporate world is a different animal altogether.

In small companies, employees wear many hats. The office computer guru may bear the official title of vice president of public relations. However, this is not commonly the case in larger companies. Here, a chemist is a chemist. He relies on the corporate information center to recommend, install, educate him in the use of, answer questions about, and troubleshoot his computer system.

Having worked in a similar environment, I know that the average professional is not a desktop-computer expert, nor should he have to be to use the tool productively. For this reason, the office standard is still with us. It would be impossible for information-center personnel to be experts on all hardware and

software in the market. Support is what keeps desktop-computer users up and running—support made possible by a focused effort on the office standard.

Brett A. Adams
Boynton Beach, Florida

■ Propane in the Tank

THE ARTICLE on alternate fuels by Christopher O'Malley ("Alternate Fuels Edge Into Auto Markets," December 1987) was interesting. However, he made no mention of propane. General Telephone and the sheriff's department in Sarasota County run most of their vehicles on straight propane. My father and I have been using propane since 1952 with very satisfactory results; we run dual-fuel vehicles to avoid problems during interstate travel.

J. V. Cavanaugh, President
Super-Sensitive Musical String Co.
Sarasota, Florida

■ Among the Top Five

HAVING READ Henry Fersko-Weiss' article "The Return of Outside Data Processing" in the December issue, I would like to understand why Citicorp Information Resources (CIR) was not mentioned in the box that listed the top five processors for banks (p. 45). In the Autumn 1987 issue of *Banking Software Review*, CIR was ranked number five among the top 40 banking software product and service suppliers.

CIR is a national supplier of data processing and information services for banks, thrift institutions, and credit unions. CIR's revenues are \$100 million and we service more than 1,200 financial institutions.

Joan Skimmons
Marketing Communications Mgr.
Citicorp Information Resources
Greenwich, Connecticut

■ Corporate Commitment

AS AN ELECTRIC-wheelchair user for 20 years, I agree that designs are getting much better, as noted in New Developments ("Thoroughly Modern Wheelchairs," January, p. 9). I bought an Invacare Arrow wheelchair in January 1987, and it's quiet and powerful. But

there's a big difference between coming up with a design and having the corporate commitment to keeping it running full-time. When the upholstery back on my chair tore after about eight months, I found out it takes two months to get a replacement. The back came in this week. Surprise! I had ordered a back 17 inches wide, and they made it 20 inches wide. So now I'm waiting for delivery some time in 1988.

I just wish Invacare had as much dedication to seeing that my chair can be serviced as they had in selling it to me.

Anthony Auer
Des Plaines, Illinois

■ A Platform for Action

I RECENTLY "retired" from operations at my electronics company and have been seeking new small investment opportunities. I have come to value your magazine as a unique source of valuable information. In addition to helping business people keep up with technological developments (which make three-year-old technology as relevant as my 1964 chemistry degree), your multifaceted reporting style is like a "due diligence" report for a potential investor.

My interests now are in developing strategic business partnerships, and your articles are particularly helpful, not just in identifying the key companies, but also in reporting the essential thoughts of the key players. *High Technology Business* provides a useful platform for action, either directly or indirectly. The "Workstation Wars" cover story in the November 1987 issue is a perfect example.

If I had to give up all but three magazines, *High Technology Business*, *Business Week*, and *Business Marketing* would stay. Thanks again for doing such a good job.

Robert Rager, President
Strategic Services
Silver Spring, Maryland

THE FACTS ABOUT FAX:



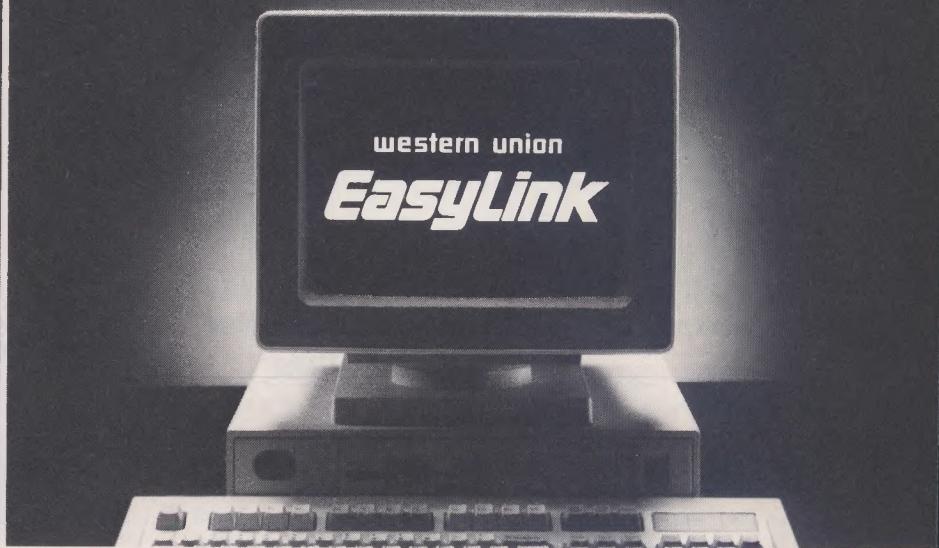
If you have a fax machine or you're considering buying one, you've made a smart move.

The fact is, fax lets you send typed documents, graphics, even handwritten notes from one fax machine to another. Quickly, conveniently and efficiently.

But as good as fax is, there are many times when your business needs to go beyond the capabilities of fax alone.

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Defense Electronics To Escape Cuts

HIGH-PRIORITY segments of the defense industry, especially electronics, could prosper even as the U.S. government cuts back on overall defense spending.

Wall Street analysts expect budget cuts to force the government to limit purchases of new planes, missiles, and ships, making it even more important to upgrade existing systems. Cutbacks in large capital purchases would hurt larger defense contractors, but could benefit small, specialized electronics firms that make state-of-the-art equipment for both new and existing weapons. Analysts also predict that defense-electronics companies will be able to take advantage of the efficiency of advanced, low-maintenance electronic systems to win deals over older technologies.

The Soviet Union's three-to-one advantage in submarines makes antisubmarine warfare one of the highest priority areas, according to analyst Stuart Levine at Gruntal & Co. Levine estimates that the Defense Department has allocated as much as \$15 billion for submarines and related systems; he says the budget for defense electronics and antisubmarine warfare could increase 15 percent per year.

Levine says quieter new Soviet subs make the need



Antisubmarine warfare spending will grow despite defense cutbacks.

OFFICIAL U.S. NAVY PHOTOGRAPH

for sophisticated submarine tracking devices unavoidable. Companies that manufacture these new submarine warning and tracking devices, such as Loral Corp. and Diagnostic Systems Inc., are beginning to generate investor enthusiasm.

To boost the company's antisubmarine warfare operations, New York-based Loral recently purchased Goodyear Aerospace Corp. for

\$588 million. The Goodyear unit produces missile guidance and sonar systems.

Meanwhile, Diagnostic/Retrieval Systems Inc. of Oakland, N.J., which makes an acoustic video-processor display designed to detect the quieter Soviet subs, recently won a contract that Oppenheimer & Co. analyst Michael Lauer estimates could generate \$50 million in revenues by 1992.

News From the TPA Battlefront

DESPITE brisk initial sales of Genentech's new drug that dissolves blood clots, experts predict its market will be smaller than expected.

Recently approved by the Food & Drug Administration, Genentech's Activase is a tissue plasminogen activator (TPA), which doctors can use to dissolve the clots that

trigger heart attacks. The drug was expected to be the first entrant in a market worth \$500 million to \$1 billion. But even though Genentech enjoyed strong sales upon FDA approval late last year, some observers soon halved their estimates of its long-term market potential. For example, James McCamant, editor of the newsletter *Medical Technology Stock Letter*, now sees a market of about \$200 million

- Baking soda makes coal burn more cleanly
- New tests improve detection of gum disease
- Robots move from the factory to the boardroom

to \$300 million for the drug.

In part, these lower estimates reflect overblown expectations earlier in the drug's history. But they also take into account the surprising effectiveness of other clot-dissolving drugs, called thrombolytics.

One such drug is Eminase, developed by Beecham Laboratories. Eminase seems to be just as effective as Activase, but produces fewer side effects such as bleeding and allergic reactions. David Webber, editor of the *Bio-tech Investor* newsletter, thinks Eminase could be approved in the United States as early as 1989.

The FDA's delay in approving Activase also could give a boost to competing TPA developers. The next contender is likely to be a version of TPA developed by Genetics Institute and sold by Burroughs Wellcome; this product could reach the market in 12 to 18 months.

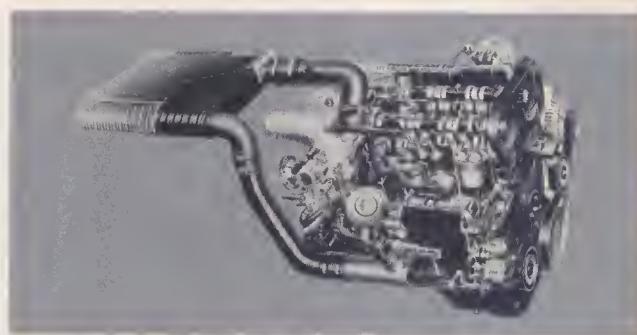
Meanwhile, Integrated Genetics of Cambridge, Mass., has developed a way to produce proteins such as

TPA in mouse milk. The company has applied for a patent on the process, and will soon begin work on producing TPA in goat's milk, which would yield higher quantities of the drug. According to a company spokesman, producing TPA in milk could help save the \$25 million to \$50 million cost of new TPA manufacturing facilities. But Integrated Genetics' product is still several years away, and competitors may already have conventional manufacturing facilities in place by the time the milk-borne TPA hits the market.

Superchargers Under the Hood

AS GASOLINE prices remain low, the consumer backlash against fuel-efficient but boring automobiles continues to grow. As carmakers search for new ways to boost the power of small engines, many are turning to supercharging.

By 1992, 4 percent of all the cars sold in the United



TOYOTA

Superchargers will join turbochargers to give car performance a kick.

States—about 400,000 vehicles—will have superchargers, according to a survey of automobile executives conducted by the Office of the Study of Automotive Transportation at the University of Michigan. Superchargers' companion technology, turbocharging, will turn up on 10 percent of new cars by then, the study predicts.

Like a turbocharger, a supercharger uses a compressor to pump air into the engine, providing more oxygen for combustion. But because a turbocharger uses the engine's exhaust to power the compressor, the driver must wait a moment before the ex-

tra power kicks in. Superchargers use the engine itself, so they work immediately and are expected to impress driving enthusiasts.

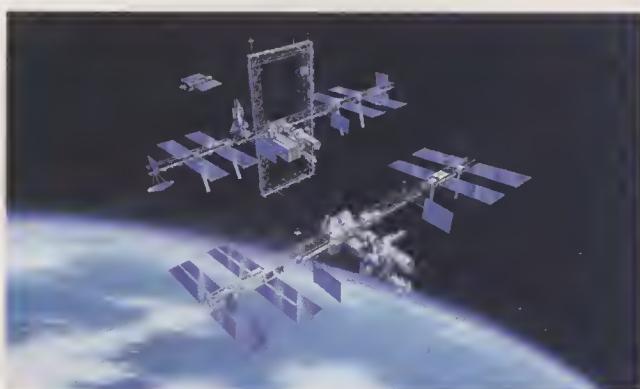
The first supercharged car in the United States is Toyota's 1988 MR-2. Among U.S. companies, Cleveland-based Eaton Corp. has perfected a system that it says Ford will install on some Thunderbird models in 1989.

Entrepreneurs may also find a place in the market. For instance, Milburn Research in Boulder, Colo., has developed a supercharger that automatically varies the amount of boost it delivers depending on engine load.

Space Station Still Not Set

NASA HAS finally chosen the contractors to build the first stage of the space station, but many observers question whether the station will be built according to current plans.

Congress will allot only half the money NASA needs to complete the station as planned, predicts John Pike, associate director for space policy at the Federation of American Scientists in Washington, D.C. After a protracted, expensive bidding process (see "Space Station Business," Aug. 1987), NASA awarded contracts worth \$1.9 billion to McDon-



Space station changes continue after NASA awards initial contracts.

nell Douglas, \$1.6 billion to Rockfordyne, \$800 million to GE, and \$750 million to Boeing. Other competitors, including Martin Marietta and Rockwell International, got nothing at all.

Construction is scheduled to start in 1994, but Pike says NASA will have to extend the program to stretch the available dollars. Pike points out that NASA has altered its designs three times in the last

three years, and expects changes to continue.

First Boston aerospace analyst Christopher Demisch agrees that a lack of clear priorities in the Reagan administration will probably lead to cuts in the space station's budget.

Observers say the companies that won awards late last year will remain in the driver's seat no matter what changes NASA makes in the program. Boeing says it plans to work on its part of the plan as it now stands, without anticipating any changes. But Rockfordyne acknowledges that changes are likely and intends to do its best to keep up with leading-edge technology.

ROCKFORDYNE

Putting the Bite On Gum Disease

TWO COMPANIES have developed tests to diagnose a gum and tooth affliction that affects more than 50 million Americans.

Most dentists detect periodontitis, which can cause the loss of infected teeth, by looking for red or bleeding gums. But a new type of test should prove more conclusive by using paper points inserted at the base of a tooth, where disease-causing bacteria live. Enzymes or DNA probes on the points detect the active bacteria.

The DMDX test from Biotechnica Diagnostics in Cambridge, Mass., has been on



New test points out periodontitis.

the market since early last year. It lets dentists test four teeth for three types of bacteria—generally enough to indicate whether active bacteria are present, according to the company. However, dentists must send the points back to Biotechnica for analysis; results take two or three days. The test costs about \$60 for the first two

sites and \$25 for each additional tooth tested.

Both Biotechnica and San Diego-based Xytronyx Inc. are working on test kits that dentists can analyze in their own offices. Colgate Palmolive expects to file for Food & Drug Administration approval later this year for an in-office kit developed by Xytronyx. This test also uses paper points inserted between the gums and teeth, but the dentist adds a reagent that causes the points to change color to indicate active disease. Biotechnica's in-office kit is still a few years away.

No prices have been set for the in-office tests, but observers expect they will be

competitive with Biotechnica's existing test. Keeping the price down is important. If the cost of the test doesn't significantly change the fee a doctor charges for a check-up, the kits could enjoy a tremendous market and help save the millions of teeth lost each year to periodontitis.

BIOTECHNICA DIAGNOSTICS

Robots Enliven Business Meetings

BY NOW, MOST people have seen a robot, but the machines can still be show-stoppers. International Robotics builds six-foot robots that have been used by such companies as IBM, Proctor & Gamble, General Electric, and Sony to give speeches at seminars, promote products, or conduct press interviews.

Robots are especially suited to discuss sensitive issues such as religion or politics, says Robert Doornick, president of International Robotics. "You forgive a robot's candor as you would a child's," he says. For example, the Stroh Brewery Company uses the robots to discuss with its retailers ways to deal with alcohol abuse.

The robots are controlled remotely by actors who appear to be part of the audience. The actor enters commands using a hand-held computer equipped with a tiny keyboard, and a wire-



Making Coal Come Clean

MOST COAL-FIRED power plants belch smoke laden with sulfur dioxide, which results in the formation of sulfuric acid—the nasty stuff in the acid rain blamed for killing fish in scores of lakes throughout the Northeast.

The dream of burning relatively cheap and abundant coal without adverse effects is inspiring two fresh approaches. The first involves

a partnership between Industrial Resources and CRS Sirrine Inc., which have developed a plan to inject coal smoke with a powder of sodium bicarbonate—common baking soda. The polluting molecules react to form solid particles that fall into the ash. Earlier attempts to use this technique were stymied by the high cost of sodium bicarbonate. But Denver-based Industrial Resources owns the rights to large sodium-bicarbonate deposits in Colorado, and has developed

a way to mine billions of tons of the material by pumping water into the ground.

Working with Houston-based engineering contractor CRS Sirrine, Industrial Resources aims to market the pollution-fighting technology to utility companies. The equipment needed to dispense the \$300-per-ton baking soda would cost about \$1 million per plant.

In the second approach, the U.S. Energy Department is funding a \$1.3-million test of a cross-flow ceramic technology at Westinghouse Electric's Pittsburgh Research and Development Center. In contrast to current techniques, the new technology attempts to clean emission gases while they're still hot, increasing efficiency. The process should work with such new ways of burning coal as coal gasification, coal-gas fed fuel cells, and combustion turbines, where temperatures exceed 1,000 degrees Fahrenheit. The filter passes dirty gases over porous sheets of ceramic tiles that trap contaminants.



Friendly robots give speeches.

INTERNATIONAL ROBOTICS

less guidance device sends digitally coded signals to the robot. The commands are coded to keep the robot from picking up random instructions from passing taxis or other radios in the area.

The New York-based company rents its robots, actor included, for \$3,600 a day. Volume discounts can lower the price to \$2,200, and after 60 days a company can get a contract preventing its robot from working for competitors. International Robotics has sold 12 robots, which cost more than \$200,000 each and take six months to build.

Paper Batteries From Japan

TWO JAPANESE companies have combined to develop a solid, paper-like conductor to replace liquid conductors in batteries for electronic products.

Matsushita Electric Industrial of Secaucus, N.J., worked with Japan Synthetic Rubber of Tokyo to revive the notion of paper electrolytes. The concept was pioneered 15 years ago by a failed joint venture of Gould Co. of Rolling Meadows, Ill., and Rockwell International.

The paper conductors, due on the market in two years, will help build smaller, more powerful batteries for use in advanced electronics. The conductors don't need containers as do liquid electrolytes, and they'll be thin and flexible enough to fit in tight spaces within a battery. Also, unlike chemical conductors, self-insulating paper electrolytes don't need bulky insulators to keep positive and negative charges separate. Maintenance-free paper does not leak or evaporate and works at a wide range of temperatures and

pressures, making it useful for space applications.

Battery makers will use paper electrolytes in primary batteries, rechargeable secondary batteries, solid-state batteries for semiconductor devices with memories, microelectronic power supplies, backup power supplies for electronic equipment, and liquid-crystal televisions now under development.

Meanwhile, research on similar polymer electrolytes, which would have many of the same uses as paper conductors, is underway in Canada and Europe.

ALSO WORTH NOTING

AIRBUS INDUSTRIE



Air beds from a French company will fit in the cargo hold of a jetliner.

■ Small pillows and tight seats often foil attempts to grab a good night's rest on long airplane flights, but travelers may soon have an alternative. By 1992, Airbus Industrie, a European consortium of aircraft manufacturers based in Toulouse, France, plans to offer air beds built into removable containers that will fit in the cargo hold of its A-340 airplane. Each container would have five beds, a changing room, an entertainment center, a refrigerator, and a bar for a nightcap at 30,000 feet. Eventually, frequent flyers might buy their own containers; four containers could be linked together to

form a 20-person suite. No airlines have yet ordered the air beds, but Airbus Industrie says several carriers have expressed interest in the concept, especially for flights to the Orient.

■ Medical patches that administer drugs gradually through the skin originally used porous membranes to transfer the medication. Soon, many patches will use tiny electric currents to push protein molecules into the body. Both kinds of patches deliver a constant supply of medication, but an improved version patented by Drug Delivery Systems Inc. of New York will use a chemical sensor to determine when to ad-

minister the drug. Dr. Robert Meyer, a director at Drug Delivery Systems and chief of pharmacology at North Shore University Hospital in Manhasset, N.Y., says the sensor patch could regulate the delivery of drugs for asthma, diabetes, and heart disease.

■ U.S. companies are betting that thin-film diamond technology will profoundly affect industrial processes in fields ranging from electronics, laser optics, and communications to machine tools. Crystallume of Palo Alto, Calif., was one of the first to join the rush to commercialize the technology and perfect the process for making the films. The basic process creates a mist of diamond droplets by heating methane and treated hydrogen in a near vacuum to about 800 degrees Centigrade. This mist can then be used to coat various items. The film would yield scissors and scalpels with a finer edge that stays sharp a lifetime. Computer memory disks coated with the film would be less

prone to errors, and coated integrated-circuit chips would shed heat better than ordinary silicon chips. These hearty chips could be packed closer together to make faster computers, and could survive in hostile environments such as jet engines. However, the new coated microchips will not be available for at least five to seven years.

■ The U.S. Patent Office has created a limited class of patents for those who don't need or can't afford a full patent. For about \$400, one-fifth the cost of a standard patent, inventors can get a Statutory Invention Registration (SIR). The Patent Office applies less rigorous standards to SIRs and grants them in about eight months, almost a year and a half sooner than patents. Even though SIR holders cannot sue to prevent a subsequent patent holder from marketing their idea, and probably are not protected from suits, an SIR does act as a public disclosure of an idea as of the filing date.

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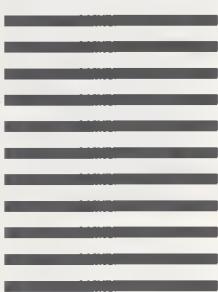


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Looking Good On Paper

**COMPANIES TRY TO SHARPEN
THE PRINTED IMAGE**

■ By Andrew M. Seybold

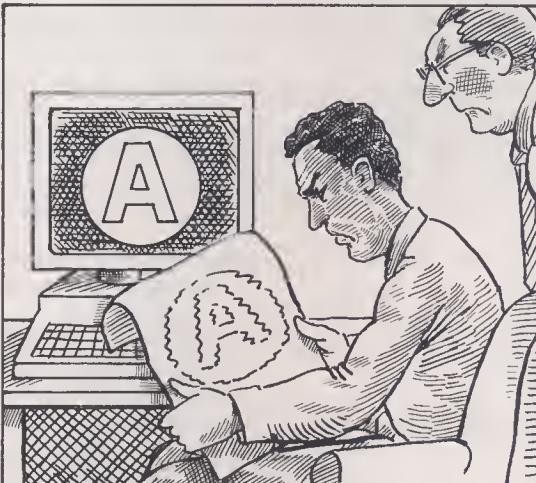
DURING THE PAST few years, as desktop-computer users have come to recognize the vital role visual images play in business communications, the ability to display those images on the screen has kept pace with their needs. In the IBM-compatible world, two display standards have emerged—the Enhanced Graphics Adapter (EGA), which provides very good text and graphic resolution, and the Video Graphics Array (VGA), which provides resolutions as sharp as 640×480 dots per inch and produces as many as 256 colors.

Despite these advances, many business users are less than satisfied with their computer's ability to communicate visually. The reason is simple: The ability to produce hard copy from a computer has not advanced nearly as quickly as the ability to display images. In other words, the clarity that users can achieve on their computer screens cannot be duplicated on paper—at least not easily and economically. Reasonably priced printer products have not been available to do the job.

Today's affordable laser printers can produce black-and-white images at resolutions to 300 dots per inch, and some printers based on inkjet or thermal technologies can produce 300-dot-per-inch color output. But this is a far cry from the high resolutions that can be achieved on computer screens. It's possible to convert computer graphics to 35-millimeter slides or even to videotape, but such devices are intended more for presentation materials than for everyday images.

The problems this mismatch creates take various forms. For example, consider the plight of someone who has created a complex image that can be displayed on a computer screen in a

multitude of colors. When the person prints that image onto paper, the result is bound to be disappointing. The abrupt switch to black and white and lower resolution will almost certainly reduce the image's impact, and may even destroy its meaning altogether. With some software-hardware combinations, a nice round pie chart on screen can turn into a distressing oval on paper.



Fortunately, progress is being made on several fronts. Challenged by the rapid advances being made in displays, companies that sell printers and other output devices are moving quickly to close the gap. The advent of new screen technologies that rely less on the hardware portion of output devices will help improve printer technology at a faster pace. Even so, the fact that computer hardware is advancing so rapidly ensures a continued discrepancy between display and output.

Companies that sell printers face a challenging future. To bridge the gap between the image quality that can be achieved on screen and that which can be printed, these manufacturers must find some way to provide reasonably priced (under \$10,000), higher-resolution output devices that can produce better-quality color images.

Among the companies making headway is QMS of Mobile, Ala., which has licensed Adobe Systems' color PostScript, the page-description language that is becoming an industry standard. Last fall, QMS introduced the first thermal color printer to work with PostScript, which it plans to ship this spring. Unfortunately, the cost of the PostScript controller card means the printer will probably cost more than \$10,000. Tektronix has announced an \$8,500 thermal color printer, but it does not support PostScript and therefore cannot take advantage of the market created by that emerging standard.

These printers cost more than many desktop-computer users can justify spending. Even so, both QMS and Tektronix are moving in the right direction, and it's clear they will continue to do so. It's also safe to assume that these trailblazers will be followed by other companies, among them Hewlett-Packard and Toshiba.

Other options being explored include the addition of gray scales to existing 300-dot-per-inch monochrome printers, and an increase in laser-printer resolution from 300 dots per inch to between 400 and 600 dots per inch. Eventually, printers that offer resolutions of 600 dots per inch or more will become widely available.

These advances will have a profound impact on office communications, because they will let business users send graphic images and other visual elements from their desktop computers. Within a relatively short time, the use of charts and other visual enhancements will probably supplant straight text-based reporting as the preferred mode of business communication. ■

Andrew M. Seybold is editor-in-chief of Andrew Seybold's Outlook on Professional Computing, a California-based newsletter.

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Memory For Microwaves

BETTER COMPUTER CHIPS CREATE SMARTER APPLIANCES

■ By Robert Chapman Wood

THE FURIOUS PACE of random-access-memory (RAM) chip development in Japan indicates how the country's vision of the future extends beyond computers to the use of such chips in consumer products ranging from television sets to ovens.

Although charges of "dumping" artificially low-priced chips on the U.S. market have slowed their introduction on this side of the Pacific, Japan's electronics giants are pushing semiconductor technology ahead faster than ever. "In the past, the density of memory chips quadrupled perhaps every three or four years," says Keiji Tachikawa, president of Nippon Telegraph and Telephone (NTT) America. "In the future, we will see it quadruple maybe every two years."

That implies a substantial increase in the already awesome pace of improvement in memory capability. Tachikawa predicts that 1-gigabit RAM chips—able to store a billion bits of information, or about 16,000 times as much as today's standard 64-kilobit chips—will be on the market within 10 years. A 64-kilobit chip, for example, can store one second of digital audio, whereas a 1-gigabit chip could hold 4½ hours' worth of digital sound. NTT, which does not manufacture chips but conducts a great deal of basic research in cooperation with many of Japan's industrial giants, showed a prototype of a 16-megabit RAM, able to store 256 times as much as the 64-kilobit chip, at the International Solid State Circuits Conference in February 1987. Meanwhile, U.S. manufacturers introduced prototypes of less powerful 4-megabit RAM chips.

The Japanese vision of the future of RAM will put megabits of memory in major appliances. "The Japanese are focusing on three major technologies

that they want to add to their high-end appliances: optical storage, voice recognition, and video image processing," says Sheridan Tatsuno, an analyst with the market-research firm Dataquest. "These technologies require lots of cheap memory. I asked a JVC executive what Japan was going to do with high-capacity memory chips, and he told me, 'When we can get a 64-megabit RAM at

vices that contain megabits of RAM would be much more useful than today's "dumb" stoves. An early indication is the automatic bread-baking system Panasonic introduced last year. This baker relies on a microprocessor and memory chips to control the process of converting flour, yeast, and water into warm loaves of fresh bread.

Japanese manufacturers such as Hitachi, Toshiba, NEC, Sony, and Matsushita will probably dominate the production of these new high-density memory chips, and of the smart appliances they will make possible. This plays to Japanese strengths: organizing massive technological efforts involving thousands of engineers at many companies, making many incremental improvements, and running smooth high-volume manufacturing processes.

But cheap RAM chips and other inexpensive semiconductors could also offer an array of opportunities for U.S. entrepreneurs. These opportunities will range from

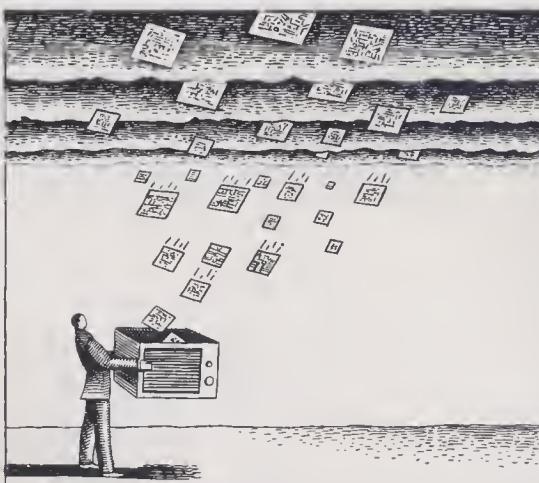
making and marketing software to producing the wide variety of specialized devices that the new components will make possible. Software sales and sales of industrial high-tech products—where U.S. companies can hope to remain competitive—promise to grow far faster in dollar terms and offer the potential for higher profit margins than will sales of memory chips and super-smart appliances.

However, the U.S. government will have to take care that protectionist attempts to shield domestic chip producers from Japanese competition don't deprive U.S. entrepreneurs of access to the technology they'll need to compete in world markets.

\$3, I will stuff my boxes with it."

A chip that holds 64 megabits could satisfy all the memory requirements for one of today's minicomputers, but NTT's Tachikawa and other spokesmen for Japanese companies confirm that they hope to put that much memory power in everyday consumer products. A television or VCR equipped with such a chip could, for example, let consumers process video and sound with more sophistication than professional studios possess today. Consumers could enlarge portions of the images on their screens, edit their own video recordings, order "instant replays," and enjoy new kinds of interactive games and educational software.

A microwave oven with a multiple-megabit mind might be able to converse with the cook in ordinary English or Japanese. Moreover, cooking de-



JAMES ENDICOTT

Robert Chapman Wood is an analyst and business consultant who specializes in technology and the Japanese economy.

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Patents Safeguard Software

POWERFUL PROTECTION TAKES TIME AND MONEY

■ By Steven J. Frank

PATENTS CAN BE a powerful safeguard for software companies. Unlike other modes of protection, a patent covers the program's function, not just the form it takes. But because of the expense and delays involved, patents are not for everyone or for every computer program.

The appeal of a patent lies in its strength—patent owners can stop others from using, making, or selling their inventions for 17 years. Subsequent independent creation can get around copyright prohibitions, and reverse engineering can expose a trade secret, but even independently written software can be held to infringe a patent.

Many kinds of software programs can be patented. The Patent and Trademark Office, which once opposed software patents for fear of an onslaught of unfamiliar applications, has had a change of heart; last year it processed about 4,000 software patent applications. Patents now cover such diverse items as accounting software, manufacturing-control systems, investment-analysis packages, and artificial-intelligence programs.

Despite the Patent and Trademark Office's growing acceptance of software patents, not all programs qualify. The Patent Act applies only to certain categories of invention, and the Supreme Court has restricted the kinds and form of software eligible for patent consideration. For stand-alone software, the program cannot be based on a law of nature or state a mathematical algorithm. Also, all patentable inventions must be novel and not obvious to a skilled practitioner in the field.

Computer programs that are part of some larger process have an easier time. An invention will not be rendered unpatentable merely because its soft-

ware component does not qualify for a patent on its own.

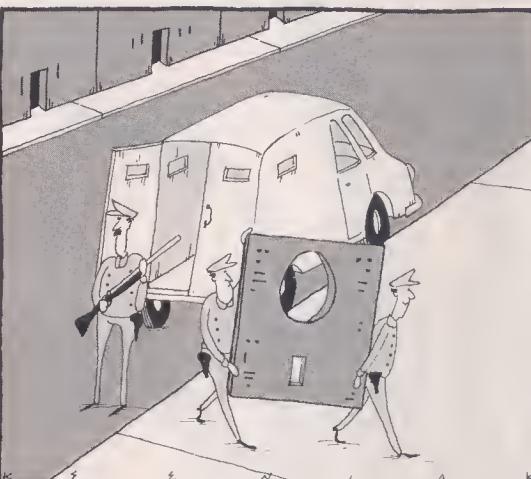
But even after a patent is granted, it doesn't offer iron-clad protection. The Patent and Trademark Office has had trouble determining whether a given piece of software is truly novel. Despite patent approval, the holder remains vulnerable if someone can later show that the claims had already been described

have extended that protection somewhat (see "Look and Feel" Lawsuits," Oct. 1987), copyright protection may still prove inadequate for software that is novel in function rather than form. For example, the software landscape might be a lot less crowded if the first company to develop spreadsheet programs had obtained a patent.

When developing new technologies, computer companies can also use patents to block the path of competitors. Even if the company is not ready to exploit the technology it has invented, a patent on the software will keep others from getting there first.

On the other side of the fence, software designers must now beware the existence of competing products patented by others. Going to market with a similar product, even if it was invented independently, could result in an expensive infringement lawsuit.

And as patent law solidifies regarding software, the industry must decide the larger issue of whether patent protection is ultimately a good thing. Will the widespread use of software patents, which give the owner what amounts to a 17-year monopoly, have a negative impact on competition, concentrating market power in the hands of a few large companies? Or will the long waiting period, coupled with the legal guidelines that limit the universe of patentable computer programs, confine the use of patents to large-scale software projects that do not threaten the vitality of the market as a whole? The answers may not be known for some time, but the arrival of patents into the mainstream of software protection is already a reality. ■



in a printed publication, or were known or in use by others in this country, before the patent holder invented them.

Cost is another consideration. Application and maintenance fees for a software patent can amount to more than \$3,000 over the life of a patent, and legal expenses can double or triple this figure. The patent approval process may take as long as two to five years, making patents ineffective for programs with a short market lifespan.

Despite these problems, the strength of patents means most companies will use them where other forms of protection fail, and to protect parts of emerging technologies.

Copyrights cost much less than patents and provide long-term protection. However, a copyright covers only program coding and certain design elements. Although recent court decisions

Steven J. Frank, who practices law with the Boston firm of Nutter, McClellan & Fish, has written a number of articles on computers and the law.



EUGENE MIHAESCU



Where Venture Capital Is Investing Now

Technology companies can still find funds, but the rules have changed

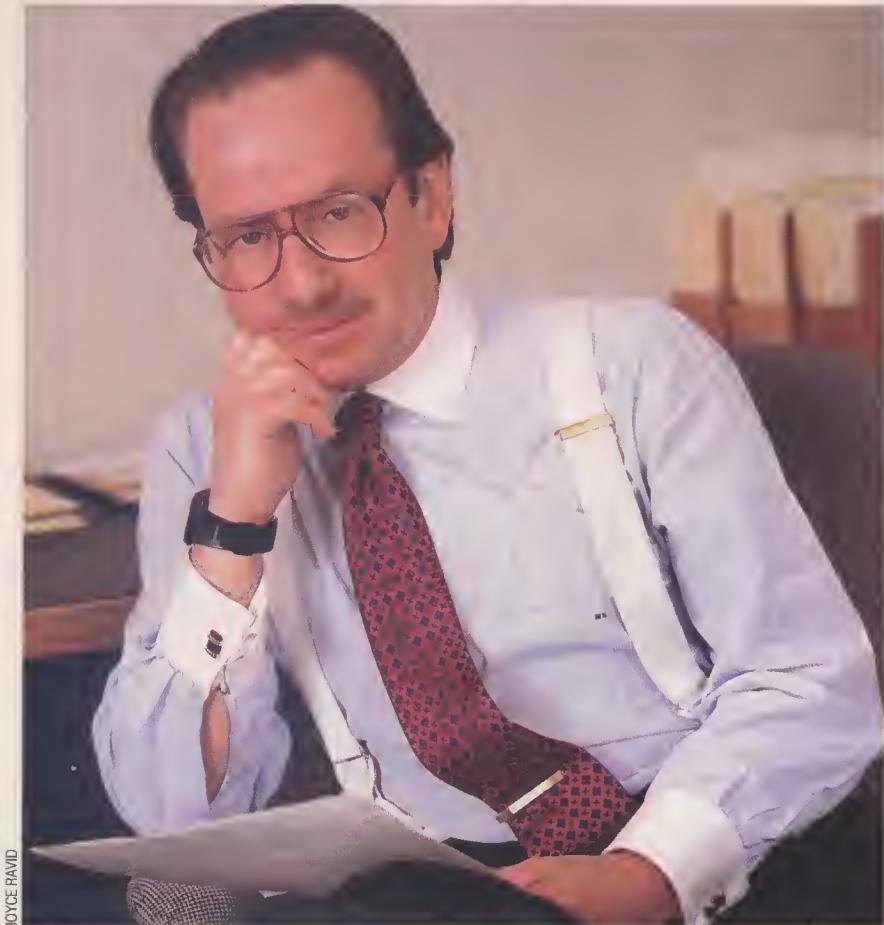
BY FREDRIC PAUL

HIGH-TECHNOLOGY STARTUP companies face a market for venture-capital dollars that has changed significantly compared to the situation that confronted such companies less than one year ago.

According to an exclusive HIGH TECHNOLOGY BUSINESS survey of more than 200 venture-capital firms, the stock-market crash of 1987 will make it more difficult for capital-intensive companies such as computer-hardware manufacturers to get the funding they need, leaving medical equipment, biotechnology, and communications as the hottest industries for venture capital in 1988.

With the depressed stock market dimming the promise of a big payoff, most venture-capital firms say they expect to see fewer new companies formed this year. Many firms say they will put more money into later-stage financing of existing companies, and explore the public market.

Apart from a drop in interest in computer hardware, the areas that attracted the most venture-capital interest in 1987—computers, communications, medical equipment, and biotechnology—will continue to domi-



JOYCE RAVID

Nissan Boury of Warburg, Pincus, the largest venture-capital firm, predicts "a needed correction."

nate 1988. But although computer ventures held the spotlight last year, they must now share it with other industries. While communications, medical equipment, and biotechnology seem to be holding steady, the number of venture-capital firms that say they specialize in the computer industry fell by 34 percent from 1987 to 1988.

On the financial front, now that the lure of lucrative initial public offerings has faded, existing companies must compete for a limited supply of capital that was also depleted in the crash. In most cases, companies will have to pay more for their money, and marginal deals may have trouble finding funds under any circumstances.

For venture capitalists with cash in the bank, the new market means bargains galore, and firms are moving to take advantage of the opportunities. In the HIGH TECHNOLOGY BUSINESS survey, firms that indicate they plan to increase high-technology investments this year outnumber those that plan to cut investments four to one, although the vast majority of respondents say their investments will remain constant. Of the more than 200 firms responding to the survey, 54 say their spending will go up, 13 say they will cut spending, and 141 indicate a relatively constant level. Overall, estimated venture-capital investment rose to more than \$3 billion in 1987, and is expected to stay at least at that level in 1988.

Where will the money go? Of the 209 survey respondents, 62 name computers as the high-technology industry where they plan to invest the most money in 1988, but that's down more than a third from the 94 firms that say they put most of their money in computers last year. Seventy-seven name computers as an industry they expect to be "hot" in 1988, another 72 respondents give the computer industry only a "lukewarm" rating, and 12 say the industry will not attract much attention at all this year. Twenty-four respondents pick computers and computer-related technologies to receive special attention from venture-capital firms in 1988.

Most blame high capital requirements for the loss of interest in computers. When the stock market crashed last October, the free-fall wiped out as much as \$1 trillion in capital. The loss of that wealth is expected to cut deepest at companies that need large chunks of capital.

"Margins have thinned out, competition is severe, and costs are high" in computer hardware, says John Baker, a partner at Allen Patricoff Associates. Under such conditions, computer companies don't have good long-term prospects, he says: "It's hard to make enough on your first product to fund the second generation of products."

Deals involving products such as mini-supercomputers will be "hard to do right now," says G. Bradford Jones, a general partner at Brentwood Associates. It's difficult to see a good return on investment if

it takes \$30 million to put a company in the black. "At current valuations, you can't make any money," he complains.

Nevertheless, the venture-capital industry is expected to pour as much money into computer companies as into any other industry. Some companies are intensifying their efforts in the field. For example, general partner Arthur Marks of New Enterprise Associates says, "We'll be looking harder for computer-related deals," because he hasn't seen much new there in the last few years.

Although many venture capitalists seem wary of computer hardware in general, specialty areas within the computer industry are attracting growing interest. For example, parallel processing has been exploding in the last couple of years, according to Daniel Haggerty, president of Norwest Venture Capital Management, and he expects that trend to continue this year. "I see large-capacity mainframes making tremendous strides in performance and enjoying downward trends in price," he says.

Computer-service companies are also solid, says Andy Paul, a partner at Welsh, Carson, Anderson, and Stowe, which concentrates on leveraged buyouts. Because service companies charge on an ongoing basis, says Paul, they can predict 90 percent of their revenue ahead of time. "When you sell widgets," he says, "even if you sold 100 million the year before, you start at ground zero every January."

THE VENTURE-CAPITAL SURVEY

This exclusive HIGH TECHNOLOGY BUSINESS survey polled 620 U.S. venture-capital firms. Telephone interviews accounted for 192 responses, and another 17 questionnaires were returned through the mail,

for a total of 209 responses. (Not every respondent answered every question, and some gave more than one answer, so the number of responses to any given question does not always add up to 209.)

1. In what high-technology industries did your company invest the greatest dollar amounts in 1987?

	NUMBER OF RESPONSES
Aerospace	2
Automobiles	2
Biotechnology	64
Communications	51
Computers	94
Consumer products	11
Electronics	48
Industrial/manufacturing	15
Materials	15
Medical products	63
Other	43

2. In what high-technology industries does your company plan to invest the greatest dollar amounts in 1988?

	4
Aerospace	1
Automobiles	62
Biotechnology	57
Communications	62
Computers	7
Consumer products	47
Electronics	25
Industrial/manufacturing	16
Materials	66
Medical products	58

3. What was your company's total investment in high-technology companies in 1987?

	41
\$1-\$5 million	97
\$5-\$10 million	67
\$10-\$25 million	25
\$25-\$50 million	1
More than \$50 million	0

4. How much does your company plan to invest in high-technology companies in 1988?

	28
\$1-\$5 million	71
\$5-\$10 million	57
\$10-\$25 million	33
\$25-\$50 million	5
More than \$50 million	0

5. Have your planned investments for high technology in 1988 changed since the recent events on Wall Street?

Substantially lower	8
Somewhat lower	27
About the same	181
Increased somewhat	11
Increased substantially	7

6. Do you expect to allocate a greater or lesser percentage of your company's investments to high-technology industries in 1988?

Substantially less	11
Somewhat less	18
About the same	176
Somewhat greater	15
Substantially greater	10

7. What is your perception of market conditions for high-technology startup companies in 1988, in both the public and private markets?

Generally favorable	28
Somewhat favorable	32
Neutral	68
Somewhat unfavorable	49
Generally unfavorable	40

8. What high-technology industries do you expect to be "hot" in 1988?

	Low	Medium	High
Aerospace	49	57	29
Automobiles	75	47	11
Biotechnology	40	35	63
Communications	8	41	127
Computers	12	72	80
Consumer products	29	74	26
Electronics	10	68	81
Industrial/manufacturing	23	79	42
Materials	18	53	82
Medical products	8	36	125
Other	0	3	21

9. More specifically, are there any high-technology sectors that you expect to generate special interest from venture-capital firms in 1988?

Superconducting	38
Software	22
Materials	18
Biotechnology	17
Medical equipment	15
Medical	16
Computers	12
Communications	19
Waste management	6
Electronics	5
Manufacturing	5
Environment	4
Fiber optics	3
Genetic engineering	3
Network computing	3
Neural networks	3
Network management	3
Robotics	3
AIDS technology	2
Aging	2
Electronic publishing	2
Optical memories	2
Agriculture	1
Artificial intelligence	1
Automobiles	1
Biosensors	1
Computer-aided design/ manufacturing	1
Computer-aided software engineering	1
Components	1
Data storage	1
Disease research	1
Energy	1
Hardware	1
High-speed processing	1
Lasers	1
Molecular engineering	1
On-line services	1
Programmable devices	1
Resource recovery	1
Semiconductors	1
Space	1
Subsystems	1
Transportation	1
Vertical niche markets	1

The real problem is that hardware development may have gotten ahead of software. "Hardware has become so cheap, so efficient," says William P. Egan of Boston's Burr, Egan, Deleage & Company, "that the value added will come more and more from software."

That trend is increasingly clear to the venture-capital community, as software companies become the hottest part of the computer industry. A total of 22 survey respondents say software will generate special interest this year.

Software companies can also benefit from ongoing revenues. Paul says that many software houses lock in half of the

year's revenue ahead of time with standard maintenance fees. He is especially intrigued by programmer-productivity companies, including computer-aided software engineering. Although companies that make such systems have gotten a lot of hype from the media, he says "the economics are too good to ignore."

Communications is often linked to computers, and the survey shows that the number of venture capitalists investing in this area will increase slightly in 1988. Fifty-seven respondents name communications as the industry where they will invest the most money this year, while 51 say communications was

SOURCE: HIGH TECHNOLOGY BUSINESS RESEARCH

TOP VENTURE CAPITALISTS LOOK AHEAD

COMPANY	ASSETS	1987-1988 INVESTMENTS	SPECIAL INTERESTS	COMMENTS
Accel Partners 1 Palmer Square Princeton, NJ 08542 (609) 683-4500	\$120 million	\$15 million in 1987, about the same in 1988	Software, telecommunications, medical products, and biotechnology; neural networks and superconductivity to a lesser extent	Partner Arthur Patterson: "The benefit of concentrating on specific industries is to know the people and the marketplace in depth. You have to fund the creation of companies in good times and bad; you can't jump in and out. Besides, we invest for five to ten years, so you can't make decisions on what's happening that day, or even over a few months."
Allen Patricoff Associates 545 Madison Ave. New York, NY 10022 (212) 753-6300	\$500 million worldwide, about half in high technology	About \$25 million— half in high technology—in 1987; about the same in 1988	Telecommunications, banking, leveraged buyouts	Partner John Baker: "The venture business will be backing fewer startups this year. The number of new companies will not be as high. The risks have been higher than anyone anticipated. Instead, we'll be looking at more mature companies, in part because of changes in the economic environment."
Brentwood Associates 11661 San Vicente Blvd. Los Angeles, CA 90049 (213) 826-6581	About \$350 million	\$30 million—about \$18 million in high technology—in 1987; about the same in 1988	Leveraged buyouts, medical technology; also active in communications and software	General Partner G. Bradford Jones: "It's a mistake to target a specific market area. We're not close enough to it. We fund people, not industries. We look for good managers in a given area who see a market need."
Burr, Egan, Deleage & Company 1 Post Office Square Boston, MA 02109 (617) 482-8020	\$250 million	About \$30 million— 80 to 90 percent in high technology—in 1987; about the same in 1988	Medical and biomedical products, semiconductors, voice and data communications, software	Partner William P. Egan: "1988 will not be bad for venture capital. One, we'll see more projects, because if companies need financing, they'll have to turn to us. Two, if public-company valuations are down, we can invest on more attractive terms. There may be a liquidity problem, but that's what our business is all about—being patient."
Institutional Venture Partners 3000 Sand Hill Rd. Menlo Park, CA 94025 (415) 854-0132	\$150 million, 90 percent in high technology	\$20 million—almost 90 percent in high technology—in 1987; slightly less in 1988	Semiconductors and semiconductor equipment, technical and scientific computers, computer-aided software engineering, computer-aided design and manufacturing, medical equipment, telecommunications, information management and data storage	Partner Reid Dennis: "If the market doesn't recover, there's no pain in investing in private companies—they can't go public. We've been buying former venture-capital deals that are now public. We're using them as a place to park cash until we need it. But public stocks have not replaced private deals. We're still looking, still active, and still honoring our commitments. We'd sell the stocks if we found a private deal that looked attractive."
Kleiner Perkins Caufield & Byers 4 Embarcadero Center San Francisco, CA 94111 (415) 421-3110	\$400 million, all in high technology	1987 investments not disclosed; should rise in 1988 with more later-stage deals	All areas of high technology, including medical products, biotechnology, computers, and software; also telecommunications in 1988	General Partner James Lally: "It's unclear what the long-term results of the crash will be. It's only certain the market is not going to remain the way it is now. The mezzanine financing market could reappear almost overnight, or another investment vehicle could fill the gap. Long-term plans based on the events of October will probably have to be revised at some point."
New Enterprise Associates 1119 Saint Paul St. Baltimore, MD 21202 (301) 244-0115	\$400 million	\$40 million— 70 to 75 percent in high technology—in 1987; about the same in 1988	Computers (including maintenance and leasing), health-care services and products (but not biotechnology), defense electronics	General Partner Arthur Marks: "We'll put some of the money in public companies this year because stock prices are so low. On a price/reward basis, stocks are more attractive than many new businesses."

their top industry investment in 1987. In addition, 127 respondents call communications a hot industry this year, 41 say it will be lukewarm, and only eight say the area will be cold.

Arthur Patterson of Accel Partners, a strong supporter of communications companies, sees a window of opportunity for companies that offer breakthroughs in systems that link today's powerful computers. Other venture capitalists expect new deals in both data and voice communications.

On the down side, Leonard Baker Jr., a partner at Sutter Hill, contends that the industry is at a low point in the technology cycle and that overall market demand is fairly soft, with an oversupply of many types of equipment.

Medical equipment and biotechnology hold perhaps the strongest appeal for venture capitalists this year. Of the survey respondents, 66 name medical equipment as the area where they will spend the most money in 1988, while 62 look to biotechnology. In 1987, 63 firms say they invested the greatest share of their money in medical products, and 64

were most heavily involved in biotechnology.

But when asked to identify how hot each industry would be in 1988, venture-capital companies cite medical products by a wide margin. A substantial 125 firms say that medical products will be a hot industry in 1988, and 35 give it a middle ranking. Only eight predict the field will be cold. A total of 31 respondents name the medical sector as an area that will get special attention this year.

The outlook for biotechnology, on the other hand, is decidedly mixed: venture capitalists complain about a glut of new companies, high capital requirements, and long paybacks. Although 63 respondents name the field as a leader in 1988, 35 give it an intermediate ranking, and a significant 46 respondents say the field will be slow this year. However, an additional 17 companies identify biotechnology as an area they expect to generate special interest.

Still, biotechnology has its defenders. Many venture capitalists remain excited about the field's potential and stress

COMPANY	ASSETS	1987-1988 INVESTMENTS	SPECIAL INTERESTS	COMMENTS
Norwest Venture Capital Management 2800 Piper Jaffray Tower Minneapolis, MN 55402 (612) 372-8770	\$250 million	About \$100 million—70 percent in high technology—in 1987; \$40 million in 1988	Historically, mainframe computers, peripherals, and software; medical technology; biotechnology; lasers. In 1988, materials technology, waste management, aerospace, medical technology, telecommunications, and computers	President Daniel Hoggerty: "We're not scared off by bad economic times. Startup companies have one- to three-year incubation terms. The early stages of a company don't create revenue anyway; the return is later. So what better thing to do than put money there now and hit the market on the upswing later?"
Oak Investment Partners 257 Riverside Ave. Westport, CT 06880 (203) 226-8346	\$250 million, 95 percent in high technology	About \$25 million—75 percent in high technology—in 1987; about the same in 1988	Biotechnology; distributed computing, including telecommunications; very high-performance semiconductors; design automation	Partner David Best: "I see a lot of confusion, a lot of organizations sitting back and saying, 'I can't for the life of me see the next wave.' Deals are not coming to us as complete or as packaged as they used to; typically, it's a couple of engineers with a bright idea. Or, we find entrepreneurs, and we give them an office and tell them to think."
Sequoia Capital 3000 Sand Hill Rd. Menlo Park, CA 94025 (415) 854-3927	\$300 million, mostly in high technology	\$22 million in 1987; will add later-stage financings to earlier concentrations on seed and early stage deals in 1988	Broad participation in medical and life sciences, services, computer software, and semiconductors	Partner Michael Moritz: "Many later-stage funds had gravitated to seed and early stage deals. There's not as much later-stage financing available, and we say there's a bit of a block hole in the market. With what's happened to the market, we're in a great position to invest in companies that can't go public or don't want to go public."
Sutter Hill 2 Palo Alto Square Palo Alto, CA 94306 (415) 493-5600	Substantially more than \$100 million, 90 percent in high technology	\$10-\$15 million—90 percent in high technology—in 1987; about the same in 1988	More in biotech, less in the computer industry; specialty semiconductors and niche-market computers	Partner Leonard Baker Jr.: "I don't expect any big changes from 1987. We do primarily startups, and I don't think what's happened in the stock market, or what may happen in the economy, will affect our startup investing plans at all."
T.A. Associates 45 Milk St. Boston, MA 02109 (617) 338-0800	\$400 million	\$50-\$75 million in 1987; \$75 million in 1988	Software and computer services; environmental services; communications; health care, especially medical products	Associate Brian Conway: "It's obvious that the stock market's troubles impacted some of our liquidity plans; we had three companies postpone their initial public offerings. But strong companies are a long-term investment. They'll get their liquidity later."
Welsh, Carson, Anderson & Stowe 1 World Financial Center New York, NY 10281 (212) 945-2000	\$540 million	\$120 million, mostly in later-stage financing and leveraged buyouts; 1988 plans not available	Companies with recurring income, such as technology services, including software and computer services; health-care products	General Partner Andrew Paul: "Spending up to \$50 million in one deal, we're moving more toward being a merchant bank than a venture-capital firm. We changed because we made a lot more money in leveraged buyouts. It's much harder to make money in the pure venture-capital game."
Warburg, Pincus Ventures 466 Lexington Ave. New York, NY 10017 (212) 878-0600	\$1.5 billion, with a significant percentage in high technology	Not available	Neural networks, superconductivity, high-end and niche-market semiconductors, advanced materials and ceramics, special areas in telecommunications	Managing Director and Partner Nissan Boury: "For those of us with lots of cash, this market is very attractive across the board. As institutional sources of capital become conservative, we think there may be more investment opportunities for venture capitalists in more mature companies than there were before, both late-round private financing and public companies. But we still strongly believe in startup and seed companies."

that many good opportunities remain to be funded.

Sutter Hill's Baker says biotechnology is still very early in its development cycle, comparable to the computer and semiconductor industries in 1968. "There's a huge amount of technology development to be done, new venture deals to be made, new companies to be started," he says.

Baker acknowledges that "biotech can be even more capital intensive than computers," always a problem in a down market. However, he adds that the long-term nature of most biotechnology research means the market could recover before the products are ready to be sold.

Accel's Patterson explains that much of the funding for biotechnology companies comes from large mainstream drug companies, easing the burden on venture capitalists.

Biotechnology generated impassioned predictions in both directions; medical products are seen as recession resistant,

and received a measured, universally optimistic appraisal.

Michael Moritz, a partner at Sequoia Capital, says the trend toward increasing investment in medical companies has been going on for several years and will probably continue. "Many companies have a larger proportion of their portfolios devoted to these companies," he says. Egan of Burr, Egan looks for investment in companies developing new drugs and ways to administer them, as well as in companies producing advances in the neurosciences.

The electronics industry should also receive continuing venture-capital support. In the survey, 47 venture-capital firms say electronics will soak up most of their 1988 investments. Forty-eight firms said they invested most heavily in electronics last year, but the decline is statistically insignificant. A total of 82 firms give the electronics industry a high rating on the "hot" scale for 1988, another 68 give it a medium rating, and only 10 respondents hand out low ratings.

Some of the venture-capital optimism for the electronics in-

dustry is based on the fall of the dollar. The lower dollar will boost domestic manufacturing, including semiconductors, predicts Nissan Boury, managing director and partner at Warburg, Pincus Ventures, which raised a \$1.2-billion venture fund last year. As imported products become more expensive, domestic demand must be satisfied by domestic sources; therefore, he says, high-end and niche-market chips will benefit the most. Any gain in U.S. chipmaking will also help the companies that build the machines that make the chips, and Warburg, Pincus is exploring opportunities with companies that build chip-inspection products, which has been a production bottleneck. Warburg, Pincus is also seeking new opportunities in application-specific integrated circuits (ASICs), which the company expects to play an increased role in the next generation of factory equipment.

Other players, including Marks at New Enterprise Associates, are high on defense electronics (see "Defense Electronics to Escape Cuts," p. 8). But the push for new investment in the electronics market is not universal. Brian Conway, an associate at T.A. Associates, sees "less pure electronics investments" and forecasts a trend toward buyouts of existing companies. The hefty investment needed to build electronics plants is also a source of concern.

After electronics, the interest in specific technology sectors wanes quickly. Twenty-five respondents say they will commit the most capital to industrial/manufacturing ventures in 1988, up from just 15 firms that concentrated on such ventures in 1987. On the scale of attractiveness to venture capital, 42 respondents rate industrial/manufacturing high, 79 call it medium, and 23 give the industry a cool reception.

Boury at Warburg, Pincus is one of the sector's supporters. He says the fall of the dollar will help stimulate "the reindustrialization of America," with a new level of technology

that should create opportunities in factory automation and other areas.

New materials will also generate significant venture-capital investment in 1988, with 16 respondents saying they will concentrate their investment in this sector; 15 companies say they specialized in materials in 1987. Surprisingly, 82 firms expect materials to be hot in 1988, and 53 say it will be at least warm. Only 18 venture firms give materials a low rating.

Superconductors are by far the hottest area of the materials industry, at least for venture capitalists—38 respondents mention superconducting as an area they think will get a lot of attention in 1988, almost twice as many as mentioned any other individual technology.

But with so much media attention, it's not surprising that some top venture capitalists engage in superconductor bashing. David Best, a partner at Oak Investment Partners, says many companies hope superconducting will be a panacea, but adds, "I'm convinced it isn't."

Patricoff's Baker worries that the market's enthusiasm for superconducting could be misplaced. "I see less potential for 100 firms backing 20 companies in superconducting," he says. "There are some opportunities, but those products are a long way from market."

Few respondents have much enthusiasm for ventures in consumer products. Only seven companies say they will devote most of their attention to the field in 1988, down from 11 last year. The aerospace and automobile sectors generate even less interest, with only five respondents showing an interest in either sector.

Though investments in particular industries should remain relatively stable, the changes in the public market will dramatically change the way venture capitalists invest.

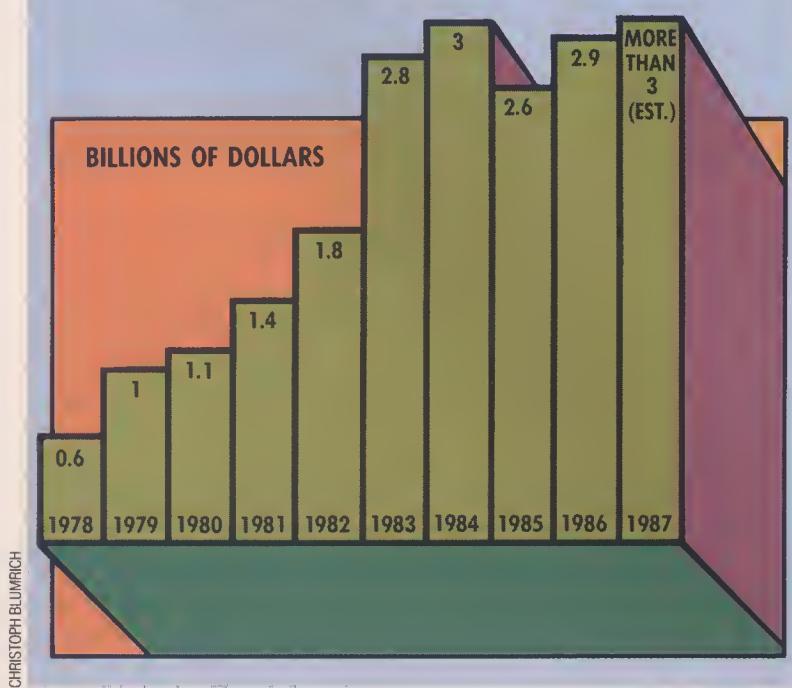
Many observers feel that the economy's troubles will diminish the capital available for venture companies, and may drive some firms out of the market. Most venture capitalists agree that most of the remaining money will increasingly go to support existing companies at later stages in their development, rather than to create new companies.

The one thing that almost everyone involved in venture capital seems to agree on is that the stock crash killed the public market for the foreseeable future.

Elimination of the big payoff takes away the biggest incentive for both entrepreneurs and venture-capital firms. Still, Boury of Warburg, Pincus says, "This is probably a good correction. The venture-capital industry has been derelict" in this regard, using the promise of an initial public offering as a way to raise money they should have provided themselves. Venture capitalists "have got to be able to nurse their companies through all the rounds, not just the first one or two," he says. "That means assigning more money per investment and more responsibility in financial planning."

New Enterprise Associates is encouraging its companies to conserve cash, says partner Marks. With all the competition for later-stage funding, "you don't want to get into a situation where you have to raise cash in a distressed situation."

VENTURE-CAPITAL INVESTMENTS IN PORTFOLIO COMPANIES



Reid Dennis, a partner at Institutional Venture Partners, warns that companies that had planned to go public this year could have problems. "Some will have to slow their growth rate and become more self-financing," he says. As the competition for late-round private financing grows, venture-capital firms will have to stand behind the companies in their portfolios. "It will be harder to get someone to pull your chestnuts out of the fire," he warns. "You'll have to do it yourself."

Companies financed in 1987 or 1986 by venture firms with limited resources will have a particularly tough time, Dennis predicts. "I think the market's going to be more selective next year, and companies without the best management team will have a hard time getting financed." Other venture capitalists show more confidence. "No matter what the economic climate, if you have an interesting product and good management, you will raise capital," says Egan of Burr, Egan. "The terms may be slightly better or worse, but there's always a shortage of good entrepreneurs."

Without the public market as a reliable option, new companies will have to make more concessions to attract capital. As a result, venture capitalists will get more for their money. "Prices across the board are lower, dramatically lower," says Sequoia's Moritz. More mature companies will feel the effects first, with startups remaining unscathed for the time being. That's because later-stage financings are generally valued in relation to companies on the public market, whereas startups are valued by history and rule of thumb, explains Brentwood's Jones.

Dropping prices will create opportunities at the mezzanine, or pre-public, level, says Norwest's Haggerty. The lack of public money may let venture firms get in cheap. Firms specializing in mezzanine-level financing are already doing a lot of work, he says, "and the market downturn is the best thing that ever happened to the leveraged-buyout business."

New Enterprise Associates, for example, is chasing bargains by shifting its investments from a historical 50/50 split between startup and follow-on funding to favor later rounds by a 60/40 margin. Like many other firms, New Enterprise is also starting to look at public companies, but Marks emphasizes that this change is not a plan but a reflection of where the firm expects to find the best opportunities.

Meanwhile, many firms expect to see fewer startup companies. The survey shows 89 respondents rate market conditions for startups as somewhat or generally unfavorable. Only 60 firms rate the market somewhat or generally favorable. Without the pot-of-gold of an initial public offering at the end of the entrepreneurial rainbow, many executives may be reluctant to leave their jobs to start new companies. Entrepreneurs may still have the fever, but market uncertainty may make it harder to entice top people to join them.

"There's a high correlation between company formations



GREG PEASE

Arthur Marks' New Enterprise Associates is leading the charge into public stocks.

and a robust stock market," says Egan of Burr, Egan. "When things are going great, [people] say, 'Hey, I'll take a shot.' Now, people are happy just to have a job." Egan also notes that "many executives exercise their stock options and use that money to start new companies." With the options worth less in a down market, that seed money won't be there.

But few observers have seen any drop-off yet, and Norwest's Haggerty expects to see more startups. Because startups are long-term investments, he says they can shield investors from exposure to market pricing.

As 1988 unfolds amid the aftermath of last year's crash and the aura of the upcoming presidential election, uncertainty about the economy seems to have reached an all-time high. The effects of fear show first in the public market, but venture capital cannot remain unaffected. "There's definitely a perception that the risk is greater now," says James Swartz, an Accel partner who is also president of the National Venture Capital Association, a trade group that represents as much as 80 percent of the country's professionally managed venture-capital firms.

Swartz predicts that 1988 will bring a sharp return to fundamentals. He sees a lengthening of the investment process from three years to five or seven years, plus a drop in deals for "me-too" companies and startup companies in general.

Ironically, this new austerity could be good for the venture-capital industry. "We all talk about funding companies with something new to offer," Swartz says, "but in reality we had slipped into financing a lot of mediocre companies."

Jane Morris, editor of the *Venture Capital Journal* newsletter and vice president of the research and consulting firm Venture Economics, sees the changing times as business as usual in the venture-capital industry. "This is a cyclical business," she says. "Sometimes it's better to be a buyer, and sometimes it's better to be a seller. Good companies take advantage of both situations."

Fax Makers Target Low-End Market

Furious competition leads to machines that offer better performance at a lower price

BY PAMELA LICALZI

Only recently an obscure niche in the office-automation market, facsimile machines have gone mainstream. A few years ago, "What's your fax number?" would have meant nothing to the average businessperson, but is now an accepted part of the business vocabulary. Suppliers claim facsimile machines will soon be as commonplace as copiers.

"There's been an incredible increase in awareness," says Steve Joerg, vice president of sales for Ricoh Corp. "People find out about fax through word of mouth, and when they try it they think it's the greatest thing since apple pie."

"We've finally hit the critical mass of users, and now things are growing exponentially," agrees Jeff Fisher, manager of facsimile marketing for Xerox Corp. "Each unit sold creates demand for additional units."

In 1987, most analysts predicted sales of 225,000 to 325,000 units. The dust is still settling, but the actual figures were closer to 400,000, up from less than 200,000 in 1986. Some manufacturers insist the market reached 500,000 units last year. Dollar sales totaled \$600 million to \$700 million, and CAP International Inc. predicts that the one-millionth fax machine will be installed in the United States this year, creating a \$1-billion market by 1990.

Although the technology behind facsimile machines was invented in the United States, Japan popularized it first because faxes can handle the complexities of written Japanese characters where typewriters can't. As a result, Japan has about twice as many fax machines as the United States, even though it has only about half the population, and the Japanese supply all the fax machines sold here.

That's one reason why profits have not soared along with sales. Although 1987 U.S. sales more than doubled the 1986 units distributed in 1986, the dollar lost 40 percent of its value against the yen. Margins are tight because products are essentially similar, and intense competition makes it market suicide to raise prices. The only way to survive is to sell more units. Facsimile-equipment suppliers dedicated themselves to doing just that in 1987, and are working even harder at it this year.

"The thing that kept the currency situation from becoming a more severe problem was the great increase in volume," says Dan Sharff, director of product development for Murata Business Systems. "Everyone in the fax market is in the same boat, because all the machines come from you-know-where."

Prices have fallen along with margins. Basic models are now selling for less than \$1,000. Fancier models cost

\$1,800 to more than \$10,000.

The fastest growth, and most of the remaining potential, is at the low end of the market. Most large companies have been using facsimile transmission for several years, but as the machines get cheaper and easier to use, small businesses are buying them as well.

"Facsimile use by small businesses will triple over the next five years," predicts Casey Dworkin, general manager of Personal Technology Research. "Any company regularly using overnight courier services is a natural user of facsimile. Not only can they get immediate delivery, they can cut costs by 90 percent." (See "Fax Hurts Delivery Services," p. 29.) The cycle of lower prices and increased value in other technology markets such as personal computers, answering machines, and modems is beginning to work in the fax market, says Dworkin.

To attack the very low end of the market, facsimile-equipment suppliers are starting to build machines that appeal to first-time users. Murata Business Systems sells a diminutive unit with all the usual features that weighs less than 10 pounds. Sharp Electronics and Canon USA Inc., two giants with considerable experience in consumer electronics, also have been particularly aggressive in targeting the low end.

For example, Sharp claims that its



RUSSELL SCHLEIPMAN

FO-210 fax machine with a built-in telephone was the best-selling unit of 1987. With a product line focused on the small-business market, Sharp says it shipped 100,000 units last year, four times its 1986 volume.

"The big market is in the low end," says Joe Cosgrove, Sharp's product marketing manager, "but this market is still in its infancy. Less than 10 percent of small businesses have fax machines."

But as the small-business market explodes, the home market remains elusive. Most suppliers agree that unit prices will have to fall to about \$500 before home sales really take off. Early this year, Murata introduced a machine that lists for just \$899, the lowest price in the industry.

The growth of the low end of the market also has affected distribution channels. Instead of selling directly to end users, most suppliers now use networks of office-equipment dealers and distributors of computers, telephone equipment, and consumer electronics. Another mark of fax machine acceptance is that retailers now sell them in the same way they do copiers, typewrit-

ers, and stationery supplies.

As some competitors struggle to cut prices, other companies are looking for ways to justify higher prices. One increasingly popular strategy is to combine facsimile machines with a variety of other office tools. Many low-end fax machines have been integrated with

telephones, and others can serve as part-time copiers and even laser printers. Murata has combined its fax machine with a videophone.

But combination products have yet to fulfill manufacturer expectations, perhaps because users cannot use the various functions simultaneously, according to Eric Arnum, editor of the newsletter *Electronic Mail & Micro Systems*. Also, copiers, which are notoriously unreliable, may not be the best partners for fax machines. "Imagine if your fax broke as often as your copier," says Murata's Sharff. Combination machines may be best suited to serve the needs of occasional users.

Other technical innovations for facsimile machines include sophisticated processors designed to make them easier to use. Many new machines will redial busy destination numbers, automatically feed documents, or store documents in memory and send them at night when phone rates are cheaper. Public-relations firms and other companies that want to reach large numbers of people have created a lively market for fax machines equipped with a "broadcast"

THE TOP 8 U.S. FAX DISTRIBUTORS

Canon USA
1 Canon Plaza
Lake Success, NY 11042
(516) 488-6700

Fujitsu Imaging Systems of America
Corp. Dr., Commerce Park
Danbury, CT 06810
(203) 796-5400

Murata Business Systems
4801 Spring Valley Rd.
Dallas, TX 75244
(214) 392-1622

Panafax
10 Melville Park Rd.
Melville, NY 11747
(516) 420-0055

Pitney Bowes Facsimile Systems
Walter H. Wheeler Jr. Dr.
Stamford, CT 06926
(203) 351-6119

Ricoh
S Dedrick Place
West Caldwell, NJ 07006
(201) 882-2000

Sharp Electronics
Sharp Plaza
Mahwah, NJ 07430
(201) 529-8200

Xerox
Xerox Square
Rochester, NY 14644
(716) 423-5078

SOURCE: PERSONAL TECHNOLOGY RESEARCH

function. These machines send the same document to many recipients after scanning it once. Xerox, Ricoh, NEC, Harris/3M, Canon, and Pitney Bowes all sell such advanced machines.

Fax machines are also being combined with other communications technologies. Converse Technology Inc. in Dallas, for example, integrates faxes with its voice-mail network, sending fax transmissions to subscribers' electronic mailboxes for delivery when the receiver is ready for them. The company says the system improves security, a common complaint among fax users.

But perhaps the most significant fax development is seemingly the most basic. New top-of-the-line copiers from Xerox, Sharp, and a handful of others can print on plain paper—the same as that used in ordinary photocopiers. Most fax machines still use slick, grubby-looking thermal paper that can be awkward to handle and hard to read.

Most plain-paper fax machines cost \$8,000 to \$10,000, but Xerox offers a less sophisticated model for about \$4,000. Fisher says Xerox can't stock enough of them. "The market for plain paper has risen dramatically from almost nothing in 1986 to at least 12 percent of sales in 1987," he says.

If the introduction of plain paper points out facsimile's link to the world of copiers, the rise of facsimile networks is a reminder that fax is primarily a telecommunications technology. So far, the vast majority of facsimile machines still talk with each other on a one-to-one basis. However, networks of facsimile machines are becoming increasingly important.

For example, FaxXchange from 3M (which spun off the rest of its fax business into a joint venture with Harris in 1986) can control large facsimile networks and monitor document traffic. Chrysler Corp. uses the FaxXchange to control its 500-machine network. "Other markets for a facsimile network switch include companies with 10 or 15 faxes but very high volume, like brokerage houses," says Michael MacKany, product marketing manager for 3M.

Some sophisticated fax machines can poll remote faxes to see if they are working and generate management re-

ports about fax traffic. Fax networking also lets fax machines receive information from devices such as personal computers or telex machines. For example, 3M's FaxXchange accepts data from computers and converts it to fax format for delivery. 3M recently enhanced the FaxXchange to let it send fax transmissions over packet-switching networks, a popular data-communications medium used by large corporations.

"Fax is branching out to tie in with personal computers and communicate over high-speed data networks," says Ricoh's Joerg. Ricoh's Model 2100 lets personal computers communicate with fax machines over leased data lines sending as many as 19.2 kilobits per sec-

sold last year—many observers tout it as the wave of the future. Virtual-facsimile products use a circuit board and software that equip the computer to code text and graphics into a form it can send through a modem. The vast installed base of personal computers opens a whole new market for fax.

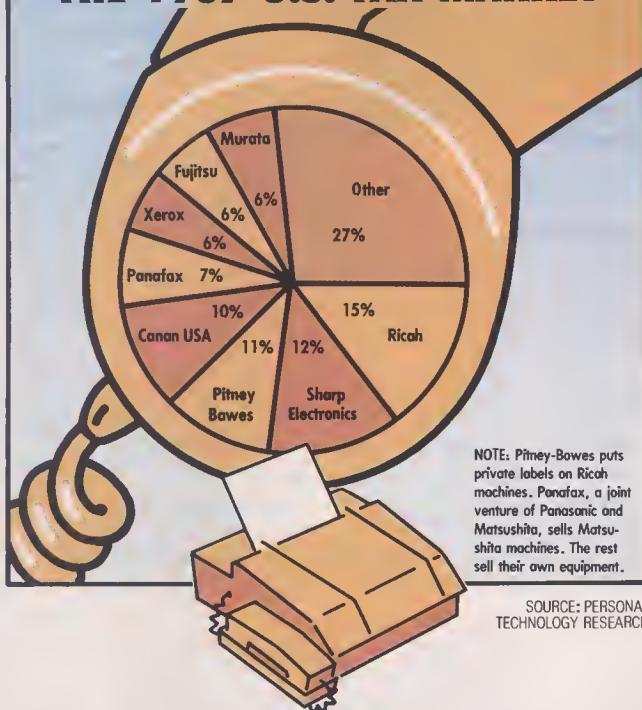
Virtual fax is currently dominated by smaller players that jumped in early on the basis of their experience with personal-computer-related products such as scanners, modems, and desktop-publishing systems. Companies such as Datatocopy and Dest (which last year purchased early market leader Gulfstream Micro Systems Inc.) moved quickly and have shown up the traditional fax manufacturers in this still-small market segment. Pitney Bowes is one of the few major companies with an available virtual-fax product.

The advantage—and primary limitation—of virtual fax is the ability to transmit documents from the point where they are typically written, the word processor, says editor Arnum. But many documents not created on word-processing systems, including pre-printed documents and scraps of all kinds, travel over telephone lines thanks to fax machines. To send these varied materials, virtual faxes must be equipped with laser printers and expensive, often temperamental, optical scanners. Worse, virtual faxes are much more difficult to use than stand-alone machines.

But Arnum adds that recent price decreases are making virtual fax boards an economical alternative, particularly for the occasional user. Such boards can now be had for less than \$1,000, about the same as basic stand-alone machines, but with more features.

Despite the flurry of new products and capabilities, the market success of facsimile machines is hastening the inevitable transition to a commodity business, with pricing, marketing, and distribution—not just technology—driving the market. The companies that enjoy success in the next phase of the facsimile market will be those that can efficiently sell their products to the customers who want them. That task is complicated by the market's spectacu-

THE 1987 U.S. FAX MARKET



SOURCE: PERSONAL TECHNOLOGY RESEARCH

CHRISTOPH BLUMRICH

ond, twice as fast as today's speediest personal-computer modems. "Fax can get a free ride on the data lines already in place in companies," says Joerg.

Xerox sells a personal-computer software package that controls a network of fax machines, creating the equivalent of a hard-copy electronic-mail network. Murata and others have brought out software to link fax networks to mini and mainframe computers.

"Virtual" facsimile, in which personal computers try to act like fax machines, is perhaps the culmination of this trend. Although virtual fax still generates more press than sales—only 15,000 were

FAX HURTS DELIVERY SERVICES

Document delivery companies are facing a hard fact: All that paper moving in and out of fax machines is the same paper that isn't moving in and out of overnight-delivery envelopes.

Few observers will estimate exactly how much booming fax sales have hurt the \$7-billion express-delivery industry. But most agree that because the cheapest overnight-mail service costs about \$10 and a one-page fax can be sent locally for as little as a dime, fax is now the delivery medium of choice for shorter documents.

"Absolutely, fax has negatively affected overnight delivery services," says Dan Sharff of fax supplier Murata Business Systems. "ZapMail was as much a defensive move as an aggressive move."

ZapMail was Federal Express' 1984 broadside at the facsimile market, a service that promised delivery anywhere in the United States within four hours using a network of fax machines. It was supposed to hit the soft underbelly of the fax business by aiming at companies that didn't send enough documents to justify the then relatively high cost of a fax machine. But Federal Express was the only thing that got zapped; it lost millions on the service and shelved it in September 1986. Customers found little advantage in four hours versus overnight, but the difference in price was substantial. Others cited poor network design.

A Federal Express spokesman says the company expects to feel some pinch from fax in the long run, but "we're still showing an increase in our document business of more than 20 percent." International Resource Development estimates that U.S. companies sent about two billion electronic messages last year, versus 100 billion pieces of regular mail.

Federal Express isn't planning any other attempts to co-opt fax sales. "We're not in the fax business," he says.

DHL, however, carefully studied ZapMail, and says it learned what not to do when implementing such a service. DHL started a facsimile-based document-exchange ser-

vice in April 1986 called DHL Electronic Document Service (EDS). Unlike ZapMail, this service targets the international rather than the domestic market, promising next-day delivery anywhere in the world.

"We've got a combined physical and electronic link for sending documents overseas, which typically used to take more than one day," says Paul Losch, DHL's marketing director. DHL couriers pick up the original documents and take them to a DHL office, where the documents are transmitted over satellite circuits operated by a DHL subsidiary to another company office in the destination city. Couriers then deliver the facsimiles by 5 p.m. the next business day. Losch says the price of this service is comparable to that of original-document delivery, at least for the first few pages. He says this system falls between instantaneous fax and "overnight" international delivery of original documents, which usually takes two days.

DHL will not say how much business the service does, but the company recently added six cities to the network; it now serves 117 of the 750 cities DHL reaches by air. Observers believe the service will soon go into the black, if it isn't already making money. EDS competes with RCA Global Communications, which has started a fax store-and-forward service to Japan, with expansion to other countries planned for this year.

Fax may worry the overnight-delivery services, but it's helping to kill the already declining market for telex and teletype. The telex market has fallen to about \$520 million, and very few new uses are entering the system. "We've been the death blow for telex," says Steve Joerg of Ricoh, because fax does not require the time-consuming task of retyping information into the telex terminal. Western Union Telegraph Corp., which diversified to become the leading electronic-mail provider after watching its telex revenue shrivel, has decided to join the enemy. The company is considering plans for a store-and-forward fax service to begin operation this year.

lar growth, which has drawn more than 25 eager new suppliers.

Unlike the computer industry, the fax business has no dominant company. The top U.S. distributors hold substantial slices of the market, but no one has been able to claim more than Ricoh's 15 percent share. "The market is as close to saturation as it can get," says Sharp's Cosgrove. "Some of these companies just went to Japan, found a box, and put their label on it. They've got no name, no service, and no distribution. They'll be out in two years."

Although few see a shakeout coming that soon, it's not clear if the smaller startups can weather a market in which distributors continue to compensate for falling exchange rates by shaving margins instead of hiking prices. Most ob-

servers agree that companies with established names, strong service organizations, and in-place distribution channels will fare better than outfits trying to push "me-too" products by cutting prices.

Many companies established in related electronics and consumer markets, such as Brother in typewriters and Minolta in photography, have also tried to cash in on the facsimile boom. Analysts question whether these companies are in the market for the long haul. Even though the facsimile market is growing at a phenomenal rate, few companies have been able to increase marketshare as well as volume. Sharp is one exception. The company's low-end focus has helped it climb to the top of the list in a relatively short time.

Confusing the issue still further, distribution patterns have been shifting even as new companies enter the market. The big battle seems to be between the Japanese companies that make the machines and the U.S. operations that resell them under their own names. Japanese outfits such as Murata and Fujitsu have moved to set up in-house U.S. sales organizations in addition to selling through distributors.

Although few of the Japanese companies look ready to give up the volume that private-label distribution deals offer, the increasing strength of their direct sales efforts may have them rethinking their strategy. "I'm beginning to seriously question why the Japanese need a middleman putting private labels on their products when they have

HOME AUTOMATION: THE EARLY LINEUP

COMPANY	PRODUCT NAME	PRODUCT DESCRIPTION
Archinetics 1750 N.W. Front Portland, OR 97209 (503) 241-2724	Max	Controls and monitors security, lighting, and energy systems. Can be programmed via telephone; has a synthetic voice.
CyberLynx 4828 Sterling Dr. Boulder, CO 80301 (303) 444-7733	SmartHome	Programmed with an Apple or IBM PC computer; links security to control of lights and appliances.
Enerlogic Systems 4 Townshend West Nashua, NH 03063 (603) 880-4066	ES-1400	Adds logical decision-making to the automation system made by X-10 USA.
Hypertek Salem Industrial Park, Rte. 22 E. Whitehouse, NJ 08888 (201) 534-9700	HomeBrain	Programmed with an IBM PC or compatible computer, which can then be disconnected or used for other tasks. Uses a touchscreen interface.
Mitsubishi Electric Sales (Medama) 5757 Plaza Dr. Cypress, CA 90630 (714) 220-2500	Home Automation System	Controls energy, security, communication, and entertainment systems; works via the phone. Video intercom monitors a child's room or sees who's at the door.
Unity Systems 2606 Spring St. Redwood City, CA 94063 (800) 558-6489	Home Manager	Emphasizes energy management; automatic dampers in ductworks adjust the temperature of individual rooms. Uses a touchscreen interface.
X-10 USA 185A LeGrand Ave. Northvale, NJ 07647 (201) 784-9700	Powerhouse; also sold through Sears and Radio Shack under their brand names	Plug-in modules that transmit on/off commands to lights and appliances through existing wiring.

SOURCE: HIGH TECHNOLOGY BUSINESS RESEARCH

of negotiation, and will probably be the first major appliance-maker to join the Smart House team.

Once these advanced dwellings begin to pop up around the country, the exclusive club of Smart House product makers will be sitting pretty. But many observers doubt the project's viability. They cite the system's radical nature, which requires major changes in wiring techniques used for most of the century. "Face it; you can't even get companies to make metric nuts," says Everett Sharey, manager of the construction products and services unit at consulting firm Arthur D. Little. Worse, the venture has been unable to attract a single consumer-electronics company. This failure alone might doom the Smart House. "People will pay for entertainment before they'll pay for convenience or security," says Sharey.

Smart House executives concede that the venture is risky. "It's a big poker game," says vice president Phillips. "Appliance makers don't want to invest in Smart House product development until they're convinced that these houses are really going to be built. But they don't want to get left behind, either."

The nature of the business deal has also come under attack. Unity Systems chairman Russ says that the short-lived period of exclusivity afforded Smart House manufacturers will make the system expensive. Makers of Smart House appliances, for example, will have to charge a premium during that limited period in order to recoup their product-development costs.

Most of all, the NAHB's secrecy rankles critics. Only fee-paying participants will enjoy access to the technology that governs exactly how signals will flow through the wiring, and many observers see this proprietary approach as a poor way to launch the home-automation industry. The business will only get going, they argue, when there is a publicly agreed-upon standard. Such openness would make the business seem far less risky to companies deciding whether to make products. "Manufacturers want to build to only one standard," says consultant Parks—and they prefer a standard without a hefty admission price.

Just such an open standard should arrive later this year from the Electronic Industries Association. The associa-

tion's Consumer Electronics Bus committee has been laboring for years on the "CEBus," a detailed set of instructions on how to encode and transmit information within the home. Products compatible with the CEBus will hit the market in early 1989, predicts Thomas Mock, who heads CEBus work at the association.

The CEBus would permit interactive communications among a wide variety of household products. The standard has provisions for all existing transmission media: power-line carriers, coaxial cable, twisted-pair copper wire, infrared light, fiber optics, and radio waves. The bus could carry information from a personal computer to a printer, for example, or from a central VCR to televisions throughout the house. The dishwasher could alert the water heater to prepare a batch of extra-hot water before starting its cycle; at other times, water could be kept cooler, saving energy.

Some of the main benefits of the CEBus would go not to homeowners, but to the companies that service them. Smart appliances plugged into the bus could detect impending failure (a low freon level in a refrigerator or air conditioner, for instance) and automatically transmit its tale of woe to a repair center such as the one GE operates. Appliance makers tied into the home in this way might lower their repair costs, because their technicians would no longer spend time on trivial problems that users could fix themselves.

The CEBus would also make it easier for electric utilities to send signals to household appliances, perhaps shutting down nonessential loads during times of maximum power demand. By shaving peak consumption, a utility could spare itself the need to build an additional power plant.

The CEBus will not solve all communication problems. "Benefits do not accrue just because of communication," cautions Honeywell's Giddings. As an analogy, Giddings points out that the global telecommunications network makes it possible to call anywhere in the world—but little is gained if the two parties speak different languages.

Still, a communications standard is a necessary first step. Home-automation companies will start to "crawl out of the woodwork" once standards solidify, says market watcher Parks. Thus, the introduction of the CEBus may serve as the long-awaited impetus to get the home-automation business moving. ■

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The cover of the August 1987 issue of *Andrew Seybold's Outlook* features a large, stylized graphic of a mountain range with a prominent peak in the center. The title "Outlook" is written in a bold, sans-serif font at the top right. Below the title, the subtitle "On Professional Computing" is visible. The left side of the cover contains several columns of text and small images related to computer news and reviews. At the bottom, there is a large photograph of a computer monitor displaying a graphical user interface with various icons.

Out on a L/I/M

On August 10, Lotus Development Corporation, Intel Corporation, and Microsoft Corporation announced significant enhancement to their two-year-old Expanded Memory Specification (EMS). L/IM EMS 4.0 (the version I/M) more than doubles the memory available for any general-use MS-DOS machine to run up to 32 megabytes of random access memory or run multiple programs simultaneously, as well as to run programs 640K to run terminate-and-stay resident (TSR) programs and software add-ons.

Intel, based in Santa Clara, California, has also announced a new 32-bit microprocessor, the i486, which will be available in early 1988.

Microsoft, based in Redmond, Washington, has announced a new version of its MS-DOS operating system, version 3.0, which includes support for the new L/IM specification.

Lotus, based in Cambridge, Massachusetts, has announced a new version of its popular spreadsheet program, 1-2-3, version 2.0, which includes support for the new L/IM specification.

Intel's new processor, the i486, is expected to be released in early 1988.

Microsoft's new version of MS-DOS, version 3.0, is expected to be released in early 1988.

Lotus' new version of 1-2-3, version 2.0, is expected to be released in early 1988.

Overall, the new L/IM specification is expected to provide significant improvements in performance and compatibility for a wide range of computer systems.

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THE HIGH TECHNOLOGY BUSINESS LEADING 100

COMPANY (SYMBOL/EXCHANGE)	RANK THIS MONTH/ LAST MONTH	PRICE INCREASE LAST MONTH (%)	CLOSING PRICE (\$)	EARNINGS PER SHARE			LATEST DIVIDEND (\$)	P/E RATIO	DEBT/ EQUITY RATIO	LATEST 12 MONTHS' REVENUE (IN MILLIONS)
				LAST QUARTER (\$)	CHANGE FROM 1 YEAR AGO	LATEST DIVIDEND (\$)				
AEROSPACE										
Hexcel (HXL/NYSE)	1/18	17.7	38.25	.67	45.7	.60	14.5	.87		332.2
Prec. Aerotech (PAR/AMEX)	2/10	17.6	5.00	.00	-100.0	—	13.5	.68		34.6
Longley (LCR/NASDAQ)	3/5	15.4	7.50	.20	-4.8	.25	13.6	.00		12.2
Gen. Dynamics (GD/NYSE)	4/26	14.5	49.50	2.62	12.0	1.00	NM	.34		9,133.3
Cdn. Marconi (CMW/AMEX)	5/12	12.8	12.13	.24	4.3	.28	NA	.01		222.1
Rockwell Int'l. (ROK/NYSE)	6/25	12.2	18.38	.51	-5.6	.66	8.1	.20		12,123.0
Curtiss-Wright (CW/NYSE)	7/16	12.1	51.00	1.85	69.7	1.60	8.7	.24		193.7
TransTechnol (TT/AMEX)	8/8	11.6	18.00	.44	.0	.80	7.3	.72		209.0
Sequa (SOA/NYSE)	9/30	11.1	50.13	1.56	66.0	.60	2.4	.43		976.5
Sundstrand (SNS/NYSE)	10/17	10.7	42.50	.72	-31.4	1.80	20.4	.49		1,399.2
CHEMICALS										
Intl. Minerals (IGL/NYSE)	1/42	43.5	48.25	.66	NE	1.00	41.2	.69		1,721.9
Locite (LOC/NYSE)	2/68	39.0	28.75	.49	44.1	.60	15.6	.06		361.1
Visto Chem. (VC/NYSE)	3/1	36.9	44.50	-4.21	-100.0	.10	NE	3.56		608.9
Quaker Chem. (QCHM/NASDAQ)	4/56	33.9	20.75	.38	22.6	.54	13.7	.13		139.9
Dexter (DEX/NYSE)	5/62	32.2	23.63	.41	24.2	.60	14.6	.44		745.6
Georgia Gulf (GGC/NYSE)	6/18	32.0	55.75	1.92	242.9	.40	12.1	1.07		650.4
LeaRond (LR/NYSE)	7/16	29.2	14.38	.22	22.2	.40	16.9	.05		136.8
Fuller H.B. (FULI/NASDAQ)	8/47	26.5	35.75	.82	36.7	.42	14.5	.27		583.7
Aristech/Chem. (ARS/NYSE)	9/37	26.4	27.50	.72	67.4	.72	12.0	.19		864.6
First Miss. (FRM/NYSE)	10/33	25.6	15.38	.72	118.2	.24	11.6	.36		302.8
COMMUNICATIONS										
Int. Telecharge (ITIL/NASDAQ)	1/4	55.2	11.25	-.05	NE	—	NE	3.00		16.0
Int. Mobile Mach. (IMMC/NASDAQ)	2/44	44.0	9.00	-.17	NE	—	NE	.01		1.4
Netwk. Equip. (NETX/NASDAQ)	3/51	42.1	20.25	.19	280.0	—	45.0	.10		61.7
Adv. Telecom. (ATEL/NASDAQ)	4/55	38.1	14.50	.29	61.1	—	12.9	.26		86.5
Checkpoint Sys. (CHEK/NASDAQ)	5/57	33.2	6.50	.05	-76.2	—	16.3	.12		35.8
Reuters Hldg. (RTSY/NASDAQ)	6/48	32.3	56.38	.59	37.2	.69	27.5	.00		1,111.6
Cellular Comm. (COMM/NASDAQ)	7/32	28.6	18.00	NC	NC	—	NE	2.64		NC
ADC Telecdm. (ADCT/NASDAQ)	8/52	27.8	17.25	.37	60.9	—	14.6	.06		166.9
Int. Tel. (INTL/NASDAQ)	9/56	26.7	4.75	.09	350.0	—	22.6	.37		46.1
AIM Tel. (AIMT/NASDAQ)	10/45	20.8	7.25	.08	33.3	—	22.7	.77		29.0
COMPUTERS										
Computervision (CVN/NYSE)	1/74	81.9	13.88	.05	25.0	—	27.2	.77		545.2
Chips & Tech. (CHPS/NASDAD)	2/184	69.2	16.50	.33	65.0	—	14.5	.04		96.4
Miniscribe (MINY/NASDAQ)	3/101	47.0	9.38	.22	29.4	—	13.8	.36		299.2
Pyramid Tech. (PYRD/NASDAQ)	4/163	45.5	8.00	.07	NE	—	61.5	.03		54.1
Storage Tech. (STK/NYSE)	5/115	44.9	2.00	.01	-92.9	—	14.3	28.46		726.1
Elec. Assoc. (EA/NYSE)	6/16	41.1	3.88	.01	-66.7	—	19.4	.06		29.2
Wyse Tech. (WYSE/NASDAQ)	7/180	39.1	22.25	.45	25.0	—	13.2	.06		334.4
Emulex (EMLX/NASDAQ)	8/53	38.9	6.25	.13	8.3	—	23.1	.02		107.6
Micropolis (MLIS/NASDAQ)	9/92	37.1	24.00	.62	40.9	—	10.8	.00		259.7
Recog. Equip. (REC/NYSE)	10/97	36.7	10.25	.35	-16.7	—	9.5	.48		264.7
DRUG MANUFACTURERS										
Carrington Lobs (CARN/NASDAQ)	1/86	63.2	15.50	-.19	NE	—	NE	.00		4.1
A.H. Robins (DRAH/NYSE)	2/84	51.0	20.38	1.10	6.8	—	5.7	.00		831.8
Molec. Biosys. (MOBI/NASDAQ)	3/27	46.6	13.75	.05	150.0	—	NE	.01		2.5
Amgen (AMGN/NASDAQ)	4/76	42.4	30.25	.02	.0	—	NM	.08		42.4
Immunex (IMNX/NASDAQ)	5/82	35.7	13.75	.16	1500.0	—	NE	1.47		8.4
Centocor (CNG/NASDAQ)	6/75	33.8	26.75	.14	-12.5	—	NE	.06		40.0
Cytogen (CYTG/NASDAQ)	7/79	29.2	6.63	-.10	-100.0	—	NE	.00		9.9
Camb. Biol. Sci. (CBIX/NASDAQ)	8/42	27.6	6.38	-.10	NE	—	NE	.01		2.9
T Cell Sci. (TCEL/NASDAD)	9/78	26.1	3.00	-.02	NE	—	NE	.00		4.5
Alco Hlth. (AAHS/NASDAQ)	10/15	26.0	15.75	.44	51.7	.12	11.3	.71		1,732.9

■ MARKET WATCH ■

The following are the 10 companies in each of 10 industries that had the highest stock gain over the previous month (figures as of 12/31/87).

NE = Negative earnings NC = Not calculable NM = No meaningful figure

COMPANY (SYMBOL/EXCHANGE)	RANK THIS MONTH/ LAST MONTH	PRICE INCREASE LAST MONTH (%)	CLOSING PRICE (\$)	EARNINGS PER SHARE			LATEST DIVIDEND (\$)	P/E RATIO	DEBT/ EQUITY RATIO	LATEST 12 MONTHS' REVENUE (IN MILLIONS)
				LAST QUARTER (\$)	CHANGE FROM 1 YEAR AGO	LATEST				
ELECTRONICS										
Micron Tech. (DRAM/NASDAQ)	1/95	77.3	14.63	.33	NE	—	NE	.34	115.6	
Hadco (HDCO/NASDAQ)	2/226	59.7	5.00	.13	-27.8	—	22.7	.52	124.3	
Integ. Device (IDTI/NASDAQ)	3/189	50.8	11.88	.09	800.0	—	51.6	.20	93.4	
Nanometrics (NANO/NASDAQ)	4/242	50.0	2.25	.00	NE	—	NE	.12	11.9	
Hytek Microsystems. (HTEK/NASDAQ)	5/208	42.9	2.50	.10	NE	—	NE	.00	19.5	
LSI Logic (LSI/NASDAQ)	6/177	41.4	10.25	.08	NE	—	53.9	.43	238.4	
Appld. Mater. (AMAT/NASDAQ)	7/108	39.7	20.25	.23	1050.0	—	NM	.21	174.4	
Silicon Sys. (SILCN/NASDAQ)	8/153	38.5	9.00	.21	-22.2	—	22.0	1.33	81.8	
Dianics (DION/NASDAQ)	9/194	38.0	1.38	-.03	NC	—	17.2	.11	3.0	
Cypress Semi. (CYPR/NASDAQ)	10/137	36.8	11.63	.09	0	—	43.1	.18	67.7	
HEALTH										
Immunomedics (IMMU/NASDAQ)	1/89	62.6	8.13	-.01	NC	—	NE	.15	4.0	
Minntech (MNNTX/NASDAQ)	2/49	40.0	8.75	-.31	-100.0	—	NE	.13	11.5	
Datascope (DSCP/NASDAQ)	3/20	35.4	32.50	.22	83.3	—	22.6	.47	91.6	
Vicon Fiber (VFOX/NASDAQ)	4/103	35.2	1.19	-.20	-100.0	—	NE	.46	10.6	
Hana Biologics (HANA/NASDAQ)	5/97	34.4	10.75	-.06	-100.0	—	NE	.13	7.9	
Biomet (BMET/NASDAQ)	6/59	31.7	20.75	.22	46.7	—	27.3	.00	59.6	
Care Plus (CPLS/NASDAQ)	7/106	31.5	2.63	.43	514.3	—	NM	.99	21.3	
Interspec (ISPC/NASDAQ)	8/92	30.5	8.00	.13	62.5	—	16.7	.00	27.1	
Aequitron Med. (AQTN/NASDAQ)	9/83	29.1	2.75	.04	-55.6	—	NE	.26	19.6	
Concept (CPCT/NASDAQ)	10/57	27.3	14.00	.12	9.1	—	24.6	.07	38.4	
METALS FABRICATION										
Trinity Ind. (TRN/NYSE)	1/18	35.9	26.50	.06	-64.7	.50	NM	1.28	516.9	
Varlen (VRLN/NASDAQ)	2/9	31.1	14.75	.49	104.2	.60	11.6	.81	153.5	
Allegheny Lud. (ALI/NYSE)	3/5	28.2	25.00	.33	57.1	.20	13.0	11.07	813.0	
Adtec (AII/NASDAQ)	4/39	22.0	4.88	.13	44.4	—	10.6	.00	12.6	
Fla. Steel (FLS/NYSE)	5/8	19.3	28.50	.80	-16.7	.80	10.2	.61	381.0	
Deltak (DLTK/NASDAQ)	6/4	16.7	7.00	.09	28.6	—	7.4	.59	26.2	
Zero (ZRO/NYSE)	7/20	16.5	15.00	.27	35.0	.36	14.6	.12	130.1	
Coml. Shear. (CSHR/NASDAQ)	8/28	16.3	14.25	.45	36.4	.56	14.3	.68	321.3	
Intl. Aluminum (IAL/NYSE)	9/14	15.6	18.50	.72	63.6	.80	9.9	.13	175.0	
Am. Locker (ALGI/NASDAQ)	10/37	15.0	11.50	.18	-33.3	.28	11.7	.03	26.0	
SCIENTIFIC AND ELECTRONIC INSTRUMENTS										
Impact Sys. (IMPAC/NASDAQ)	1/91	81.8	5.00	.07	75.0	—	26.3	.09	26.2	
Sec. Tog Sys. (STAG/NASDAQ)	2/76	56.3	2.25	.02	100.0	—	NE	.08	6.2	
Laser Photo (LAZR/QTC)	3/96	50.7	1.13	-.01	NE	—	NE	1.45	4.4	
Resdel Ind. (RSDLIC/NASDAQ)	4/75	50.0	5.25	.00	-100.0	—	30.9	4.14	17.6	
Tinsley Labs (TNSL/QTC)	5/80	42.9	5.00	.28	86.7	—	NE	.32	6.1	
CEM (CEMX/NASDAQ)	6/57	40.5	14.75	.19	46.2	—	23.8	.00	10.6	
Hoch (HACH/NASDAQ)	7/43	33.3	16.00	.24	33.3	.20	20.3	.12	44.1	
Acuson (ACSN/NASDAQ)	8/29	32.1	18.50	.19	58.3	—	28.9	.01	93.6	
Knogo (KNG/NYSE)	9/40	31.8	17.63	.39	11.4	.30	13.0	.00	54.0	
Resource Eng. (RSE/AMEX)	10/89	30.1	10.25	.10	100.0	—	27.0	2.05	47.8	
SOFTWARE AND DATA PROCESSING										
Aero Svc. (AERO/NASDAQ)	1/94	75.2	2.19	-.28	-100.0	—	NE	1.87	66.6	
Comp. Factory (CFA/NYSE)	2/128	51.3	15.13	.19	90.0	—	15.9	.00	187.0	
Ashton Tate (TATE/NASDAQ)	3/76	50.0	24.38	.44	33.3	—	15.0	.04	254.7	
PDA Eng. (PDAS/NASDAQ)	4/133	50.0	4.50	.05	-28.6	—	75.0	.07	21.7	
Sys. Soft. (SSAX/NASDAQ)	5/23	48.6	13.75	.22	100.0	—	20.2	.03	30.9	
Informix (IFMX/NASDAQ)	6/37	41.8	25.88	.21	90.9	—	46.2	.00	34.3	
Innov. Soft. (INSD/NASDAQ)	7/53	40.8	17.25	.20	185.7	—	27.8	.02	21.8	
Duquesne Sys. (DUON/NASDAQ)	8/16	37.1	21.25	.20	42.9	—	28.3	.00	37.7	
Oracle Sys. (ORCL/NASDAQ)	9/93	33.3	14.50	.05	400.0	—	50.0	.11	155.0	
Interleaf (LEAF/NASDAQ)	10/80	32.1	18.50	.08	NE	—	77.1	.04	44.7	

SOURCE: MEDIA GENERAL FINANCIAL SERVICES

Companies Struggle To Automate Homes

The business of home automation takes its first tentative steps, spurred by a controversial national project

BY HERB BRODY

FOR YEARS, optimists have been predicting huge markets for systems that turn the home into an obedient and intelligent servant, equipped to ward off burglars, switch on appliances, and adjust the thermostat. But as often happens with innovative technologies, big companies are waiting on the sidelines while the little guys test the market. The contestants in this embryonic business, however, have sustained themselves more on hope than on actual sales.

Depending on how it is defined, the home-automation market in 1987 totaled between \$50 million and \$350 million. "The market is a gleam in our eye," says Harry Krall of Cardinal Technologies, an RCA spin-off that this year will begin to sell computer products such as modems and printers designed for the automated home.

Analysts predict that by the mid-1990s, billions of dollars a year will go toward converting ordinary residences into "smart" houses. In 1995, 4 percent of all new homes will come with a central computer-control system, predicts market-watcher Patricia Parks of Parks Associates. During the next five years, that will shoot to 10 percent.

Home automation appeals mainly to buyers of houses that cost \$250,000 or more. Robert Russ, chairman of start-up Unity Systems, defines the target as the top 5 to 10 percent of new houses and the top 5 percent of existing ones. That comes to 50,000 to 100,000 homes per year, says Russ.

Many observers find it hard to conceal their frustration with the sluggish growth of the home-automation business. "The industry is taking longer to pick up than anticipated," says Roger B. Dooley, publisher of *Electronic House* magazine. "A few years ago, the explosion was predicted to be right around the corner. It still hasn't happened."

Even though the real race has yet to begin, the contestants are battling furiously for position. Events on several fronts warrant close watching:

- A clique of scrappy entrepreneurial companies is offering commercial home-automation systems. New entries are spicing up the field, and venture capitalists are starting to take notice.
- Big companies are preparing to dive into the fray.
- The National Association of Home Builders is orchestrating a multi-industry consortium that aims to radically alter the way homes are built, making

automation as integral a part of the building as electricity and plumbing. A variety of companies—mainly manufacturers of such prosaic items as electrical cable and connectors—are joining the consortium in hopes of gaining the competitive edge when smart houses come on the market, possibly in the next two to three years.

■ The Electronic Industries Association intends to publish a standard language that will let home appliances communicate with one another.

The biggest obstacle facing companies in this nascent industry is how to convince consumers that an automated home is worth the money. The situation is reminiscent of that of personal computers in the late 1970s; available products appeal mainly to electronics hobbyists. "When we entered this business in 1982, we got a lot of blank stares," says Marty Burns, president of Hypertek. The main benefit of home automation, says Burns, is "a sense of well-being. That's not always easy to understand."

A relative newcomer to the business expresses similar frustration. "The problem is that there is no single feature that justifies a home-automation system," says Russell Evans, president of Archinetics, a small company that is



ILLUSTRATIONS BY JAMES ENDICOTT

challenging Unity and Hypertek for an early share of the market.

Indeed, today's home-automation systems offer benefits from the clearly useful to the frivolous. The basic idea is to make a house run itself, with minimal human intervention. Before retiring for the night, for example, people might go through a ritual such as turning certain lights on and off, making sure appliances are off, arming a security system, turning down the thermostat, and running the dishwasher so that it uses less expensive off-peak electricity.

Automating these tasks requires little new technology. Devices that have been on the market for several years, such as power-line carrier modules from X-10 USA Inc., can perform most rudimentary home-control functions. X-10's modules operate lights, appliances, and heating systems according to a programmed schedule. On/off instructions flow through a house's existing wiring. You could thus order the porch light to turn on before you arrive home from work, and the thermostat to set back every night, all through one central console.

It's also possible to link a home-control system to a burglar alarm. In addition to triggering a siren, an intrusion might make all the lights flash on and

off in unison, helping identify the invaded house to police.

X-10 USA sells these systems both directly and under the Sears and Radio Shack labels. Business is booming—1987 sales were triple those of 1986, according to president Peter Lesser. From 1985 to 1986, sales shot up 30 percent, and another 53 percent in 1987.

The module costs about \$10 and needs no additional wiring. However, it passes signals only in one direction, from the central console to the lights and appliances. Far more sophisticated automation will come from systems that can pass messages back and forth and from point to point.

The company most closely identified with home-control equipment, Honeywell, is marketing dozens of individual gadgets but no system to link them together. Although obviously interested in home automation, Honeywell has chosen not to take the lead in what is known as whole-house systems. "People don't want an automated home," says Richard Giddings, Honeywell's manager of home and building automation research. "They want a home that's comfortable to live in. There must be enough of a ben-

efit to put up with the hassle."

The first major corporate entry into the home-automation field will come from Japan: Mitsubishi Electric has announced plans to start marketing a system later this year. The company has sold a home-automation system domestically for several years. However, because Japanese and U.S. lifestyles are so different, Mitsubishi enlisted a U.S. company, CyberLynx, to design the system that will be sold here. CyberLynx has offered a home-control system called SmartHome for several years, with limited success.

The Mitsubishi system, which will be sold through its Medama subsidiary, resembles those from Unity and Archimetics. Like its competitors, Mitsubishi is aiming for the high-end home buyer; installed systems will cost \$10,000 to \$20,000. Medama is testing the system in selected homes and will start production by mid-year, according to Dany Ray, director of market development.

These plans have generated some skepticism. Market analyst Parks predicts that there will not be enough demand to make the Mitsubishi system profitable. Other observers point out that the Japanese giant has previously announced U.S. marketing plans that

VIEWS OF THE SMART HOUSE VENTURE

The National Association of Home Builders' Smart House project promotes a radical concept of home automation. The NAHB has created a consortium to develop products, and licenses members to use proprietary

technology. The project started in 1985; so far, 41 companies have signed contracts to make parts of the Smart House. Here are comments from four companies that have signed on and two that have not.

PARTICIPANTS

Brintec, Brand-Rex Division Willimantic, Connecticut

"Our product would be used in every Smart House, so there's a big potential gain for us if the project succeeds," says Hershall Willis, senior product engineer. Brintec has negotiated a license to manufacture electrical wire and cable that combines conductors, telephone wire, and coaxial cable in one tube. The company hopes that its early involvement will earn the preference of the contractors who will build smart houses.

Lennox Industries Dallas

"We're excited about our involvement with the Smart House project," says president and CEO John N. Norris Jr. Lennox bills itself as the technology leader in the residential furnace industry—it made the first commercial pulsed-gas furnace—and the company sees its participation in the consortium as consistent with that leading-edge image. "We expect Smart House to succeed and we want to be in on the ground floor," says spokesman Howard A. Olsen II.



Honeywell Minneapolis

The Smart House "has the potential to define and start the home-automation market," says research manager Richard Giddings.

He thinks that true home automation will be almost impossible to achieve economically in an existing home. Giddings believes that the companies that get on board early have a chance to shape the business to their benefit. "The train is leaving the station, and we're riding up front with the engineer," he says.

Square D Cedar Rapids, Iowa

"The home will become smarter, and Square D needs to be ready," says John Schultz, who manages Smart House activities at this manufacturer of circuit-breaker panels and other electrical equipment. "We see an increased connection between the electrical network and the other networks in the house, such as the phone system." Square D joined the Smart House consortium early and stuck with it through its first erratic years. "My confidence in the program has increased recently," Schultz says.

RESISTERS

Archinetics Portland, Oregon

The Smart House project is "a lot of research and endless going around in circles," says spokesperson Gail George. "They're on some other planet—not at all product oriented." Archinetics, which makes a whole-house automation system, has shunned the Smart House venture, viewing its commercial potential as remote, at best. "We're more involved with the Electronic Industries Association's work, which is a lot more viable."



X-10 USA Northvale, New Jersey

"Those guys are tilting at windmills," says president Peter Lesser. "This isn't going to happen until the 21st century." X-10, whose lamp- and appliance-control modules are central to the home-automation market, disdains the Smart House project. Lesser predicts that the Smart House will founder when it gets into the hands of the tradespeople who actually install it. The Smart House's sophisticated wiring scheme will baffle electricians, he contends.

have failed to materialize.

But if Mitsubishi delivers, the ramifications would be significant. By publicizing its product, the company would promote the concept of home automation in general. Indeed, competitor Archinetics is "waiting anxiously for Mitsubishi" to come in, says Gail George,

whose official title is product evangelist. "We'll all benefit from Mitsubishi's advertising."

This sounds eerily familiar to those who have followed the business. In 1985, virtually identical hopes were pinned on General Electric, which introduced an inexpensive system called

Homeminder. But GE never promoted the product as heavily as it promised to and, after two years of meager sales, yanked Homeminder from the market.

Home-automation companies are aiming their systems primarily at new construction, for two reasons. First, the logical time to equip a home for automa-

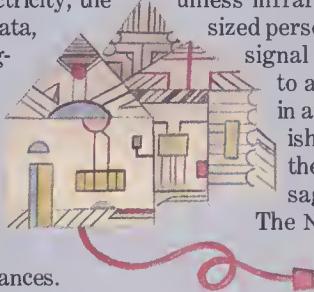
HOW THE SMART HOUSE WOULD WORK

The Smart House envisioned by the National Association of Home Builders (NAHB) would differ radically from an ordinary dwelling. The main change is in the wiring system. Today's houses contain multiple cables for different functions: electricity, telephone service, cable TV, security systems, doorbells, and thermostats.

The Smart House's design calls for a single cable containing three wires. The first wire would carry electricity, the second would transmit control signals and data, and the third would handle audio and video signals. Because each wire would connect to each outlet in the house, these multipurpose receptacles could accommodate a variety of appliances, from toasters and hair dryers to telephones, stereo speakers, and smoke alarms. In addition, flexible gas piping would be installed throughout the house; electronically controlled valves could then automate gas appliances.

The NAHB's plan also offers unique protection from electrical hazards through a feature called closed-loop power. When a Smart House appliance gets plugged into the socket, it starts an electronic conversation with a central power controller. The appliance sends a signal to identify itself and specify how much current it needs.

Only upon receiving such a request will the controller release power to the outlet; otherwise, it remains dead. Thus, a baby could safely stick its finger in the outlet. The



appliance must continually acknowledge that it is receiving the power it has asked for and that it wants power to continue. Lack of such an acknowledgment triggers the controller to stop sending power to that outlet.

Other features could come from the interaction between appliances. For example, the controller could be programmed not to send any gas or electricity to the stove unless infrared sensors in the kitchen detect an adult-sized person. The ringing of the doorbell could relay a signal to the controller telling it to cut off power to any vacuum cleaner that might be plugged in at the time. Or, when a washing machine finished its cycle, it could pass the word along to the television set, which would flash the message on its screen.

The NAHB has scaled back its technological adventurism since it proposed the Smart House to a puzzled world in 1984. As first described, the house was to provide something called programmed power—appliances would receive electrical power in a variety of forms, including direct current and high-frequency alternating current. But the energy-efficient appliances that could exploit these unusual electrical styles are not yet available, so the NAHB now plans for the Smart House to offer only 120/220-volt, 60-cycle alternating current—the same juice that runs through the copper veins of conventional houses.

tion is before it's finished; stringing wire is much easier and cheaper before walls and ceilings go up. Second, the cost of an automation system inflicts less pain when it can be paid over a 20- or 30-year mortgage. A \$10,000 system might add \$100 to the monthly payment, a tolerable burden for someone buying a \$200,000 house.

But inside the new-construction market lurks a potentially formidable adversary for home-automation companies—the National Association of Home Builders (NAHB). For the past three years, this organization has been pushing an ambitious and increasingly controversial project called Smart House. If the project succeeds, it will compete directly with the fledgling home-automation business. It also could bring diverse companies into the arena, from cable manufacturers to toaster makers.

The NAHB exists to promote the construction and sale of new houses. The Smart House project is, in essence, an elaborate scheme to give the home buyer a reason to prefer a newly built house over an old one. The group is pursuing its goal with an unusual business strate-

gy—it has set up a wholly owned subsidiary, the Smart House Development Venture, to promote the concept. The venture developed a radical new method of wiring homes that not only eases automation but also greatly lessens the chance of electrically caused fires or injuries (see "How the Smart House Would Work," above). The project cleared a significant hurdle last year when the National Electrical Code was revised to permit the new type of wiring.

The NAHB has also created a multiple-industry consortium. To join, companies pay a one-time fee and agree to help develop products to take advantage of Smart House's unique features. In return, the NAHB licenses the companies to use a proprietary integrated-circuit chip that will make their products compatible with all others in the Smart House. The price of entry has escalated, from as low as \$10,000 when the project started in 1985 to about \$100,000, according to Smart House spokesman Ken Geremia.

To begin with, the NAHB will license three companies per product category. This triopoly will last for the first four years that Smart Houses are on the

market. The NAHB is pitching the deal to companies by implying that the train is boarding; once it starts rolling, non-participants will be left at the station as the train chugs off into the promised land of home-automation profits.

So far, 41 companies have signed contracts to make pieces of the Smart House. Most produce what the NAHB calls the "core"—the cable, outlets, connectors, and so forth that will hide behind the walls and make the whole system work. "Ninety percent of the dollar value of the core products is now signed up," says Keith Phillips, the venture's marketing vice president. The NAHB has had to fend off applicants for certain products, particularly the "power block"—the computer-controlled wall socket that Phillips calls the most revolutionary item in the Smart House.

With this infrastructure in place, the venture is trying harder to sign up appliance makers. Manufacturers of heating, ventilation, and air-conditioning equipment have filled up their product categories. Next, the venture is focusing on less fundamental items such as refrigerators and washing machines. Whirlpool has reached advanced stages

HOME AUTOMATION: THE EARLY LINEUP

COMPANY	PRODUCT NAME	PRODUCT DESCRIPTION
Archinetics 1750 N.W. Front Portland, OR 97209 (503) 241-2724	Max	Controls and monitors security, lighting, and energy systems. Can be programmed via telephone; has a synthetic voice.
CyberLynx 4828 Sterling Dr. Boulder, CO 80301 (303) 444-7733	SmartHome	Programmed with an Apple or IBM PC computer; links security to control of lights and appliances.
Enerlogic Systems 4 Townshend West Nashua, NH 03063 (603) 880-4066	ES-1400	Adds logical decision-making to the automation system made by X-10 USA.
Hypertek Salem Industrial Park, Rte. 22 E. Whitehouse, NJ 08888 (201) 534-9700	HomeBrain	Programmed with an IBM PC or compatible computer, which can then be disconnected or used for other tasks. Uses a touchscreen interface.
Mitsubishi Electric Sales (Medama) 5757 Plaza Dr. Cypress, CA 90630 (714) 220-2500	Home Automation System	Controls energy, security, communication, and entertainment systems; works via the phone. Video intercom monitors a child's room or sees who's at the door.
Unity Systems 2606 Spring St. Redwood City, CA 94063 (800) 558-6489	Home Manager	Emphasizes energy management; automatic dampers in ductworks adjust the temperature of individual rooms. Uses a touchscreen interface.
X-10 USA 185A LeGrand Ave. Northvale, NJ 07647 (201) 784-9700	Powerhouse; also sold through Sears and Radio Shack under their brand names	Plug-in modules that transmit on/off commands to lights and appliances through existing wiring.

SOURCE: HIGH TECHNOLOGY BUSINESS RESEARCH

of negotiation, and will probably be the first major appliance-maker to join the Smart House team.

Once these advanced dwellings begin to pop up around the country, the exclusive club of Smart House product makers will be sitting pretty. But many observers doubt the project's viability. They cite the system's radical nature, which requires major changes in wiring techniques used for most of the century. "Face it; you can't even get companies to make metric nuts," says Everett Sharey, manager of the construction products and services unit at consulting firm Arthur D. Little. Worse, the venture has been unable to attract a single consumer-electronics company. This failure alone might doom the Smart House. "People will pay for entertainment before they'll pay for convenience or security," says Sharey.

Smart House executives concede that the venture is risky. "It's a big poker game," says vice president Phillips. "Appliance makers don't want to invest in Smart House product development until they're convinced that these houses are really going to be built. But they don't want to get left behind, either."

The nature of the business deal has also come under attack. Unity Systems chairman Russ says that the short-lived period of exclusivity afforded Smart House manufacturers will make the system expensive. Makers of Smart House appliances, for example, will have to charge a premium during that limited period in order to recoup their product-development costs.

Most of all, the NAHB's secrecy rankles critics. Only fee-paying participants will enjoy access to the technology that governs exactly how signals will flow through the wiring, and many observers see this proprietary approach as a poor way to launch the home-automation industry. The business will only get going, they argue, when there is a publicly agreed-upon standard. Such openness would make the business seem far less risky to companies deciding whether to make products. "Manufacturers want to build to only one standard," says consultant Parks—and they prefer a standard without a hefty admission price.

Just such an open standard should arrive later this year from the Electronic Industries Association. The associa-

tion's Consumer Electronics Bus committee has been laboring for years on the "CEBus," a detailed set of instructions on how to encode and transmit information within the home. Products compatible with the CEBus will hit the market in early 1989, predicts Thomas Mock, who heads CEBus work at the association.

The CEBus would permit interactive communications among a wide variety of household products. The standard has provisions for all existing transmission media: power-line carriers, coaxial cable, twisted-pair copper wire, infrared light, fiber optics, and radio waves. The bus could carry information from a personal computer to a printer, for example, or from a central VCR to televisions throughout the house. The dishwasher could alert the water heater to prepare a batch of extra-hot water before starting its cycle; at other times, water could be kept cooler, saving energy.

Some of the main benefits of the CEBus would go not to homeowners, but to the companies that service them. Smart appliances plugged into the bus could detect impending failure (a low freon level in a refrigerator or air conditioner, for instance) and automatically transmit its tale of woe to a repair center such as the one GE operates. Appliance makers tied into the home in this way might lower their repair costs, because their technicians would no longer spend time on trivial problems that users could fix themselves.

The CEBus would also make it easier for electric utilities to send signals to household appliances, perhaps shutting down nonessential loads during times of maximum power demand. By shaving peak consumption, a utility could spare itself the need to build an additional power plant.

The CEBus will not solve all communication problems. "Benefits do not accrue just because of communication," cautions Honeywell's Giddings. As an analogy, Giddings points out that the global telecommunications network makes it possible to call anywhere in the world—but little is gained if the two parties speak different languages.

Still, a communications standard is a necessary first step. Home-automation companies will start to "crawl out of the woodwork" once standards solidify, says market watcher Parks. Thus, the introduction of the CEBus may serve as the long-awaited impetus to get the home-automation business moving. ■

IBM Opens the Door For Entrepreneurs

*A new breed of small companies is poised to cash in on OS/2,
the next generation of personal-computer software*

BY CHRISTOPHER O'MALLEY

THE OLD SAYING "opportunity knocks but once" does not apply to the personal-computer business. Not only can opportunity knock again, it can knock so loudly that even people who struck it rich during the first calling will drop everything for another try.

A second chance to cash in on software for personal computers has been created by IBM and Microsoft's joint launch of a new standard called Operating System 2, or OS/2. An operating system is essential software that controls the way a computer organizes and processes information; it is a traffic cop that tells the machine how to execute the commands you punch into it. OS/2 directs traffic so effectively that it clears the way for new computer programs written to take advantage of the system—programs that will far outclass much of the software used today.

A number of new companies plan to take advantage of this development. Several are backed by some of software's leading entrepreneurs, the whiz kids who built reputations and fortunes by creating the programs that make personal computing such a pervasive business tool. Given the past performance of their founders and the wide-open market for OS/2 products, these fledgling companies stand a good chance of becoming the giants of a new software industry.

Leading the lineup is On Technology,

led by Mitchell Kapor, the former head of Lotus Development in Cambridge, Mass., and creator of Lotus 1-2-3. Next come the startups Go and Asymetrix. Asymetrix was founded by Paul Allen, who joined with Bill Gates about 10 years ago to start the software giant Microsoft, based in Redmond, Wash. Go is the child of S. Jerrold Kaplan, another former Lotus technologist, and

Robert M. Carr, who was chief scientist for database supplier Ashton-Tate of Torrance, Calif.

Unlike these startups, two other recently established companies—Micrografx and Blyth Software—already offer software that is picking up market momentum. These programs will have proven capabilities when they are used with OS/2 machines.

On Technology

FOUNDED 1987

FINANCING Undisclosed amount from chairman

EMPLOYEES Fewer than 10

PROPOSED OS/2 PRODUCT
A building-block platform for software developers

STRATEGY To convince developers, particularly at smaller companies, that its building blocks offer a more coherent, cost-effective way to create new programs.

1 Cambridge Center
Cambridge, MA 02142
(617) 225-2545



Mitchell D. Kapor, chairman

SETH RESNICK/PICTURE GROUP

Asymetrix

FOUNDED 1985

FINANCING Undisclosed amount from president

EMPLOYEES 28

PROPOSED OS/2 PRODUCT

High-end business programs

STRATEGY To create easy-to-use software that addresses business problems by combining new and old ideas.

110 110th Ave. N.E.
Bellevue, WA 98004
(206) 462-0501



■ Paul G. Allen, president

All five companies hope to capitalize on opportunities that haven't been seen in the software business since 1981, when the IBM PC created an industry standard from Microsoft's operating system MS-DOS (which stands for Microsoft-Disk Operating System). Application software—spreadsheets, word-processing programs, and the like—are tied to a computer's operating system; any machines with the same operating system and basic hardware architecture can run the same software. When a system becomes as pervasive as MS-DOS, software suppliers have a vast and unified market eager for their wares. The rise of DOS helped build the fortunes of Lotus, Ashton-Tate, and even Microsoft, which writes many application programs for its own operating systems. By all indications, OS/2 will quickly become as pervasive, supplanting MS-DOS as the most popular personal-computer operating system.

OS/2 has significant technical advantages. The system is not constrained by the meager memory space and one-job-at-a-time approach of DOS, and therefore will accommodate a new class of more sophisticated programs that combine many tasks handled separately in DOS computers. Yet people will control OS/2 programs through simple menus and windows.

Also boosting OS/2 is the growing

popularity of personal computers built around Intel Corp.'s 80286 and 80386 microprocessors, the powerful chips needed to run the new system. DOS does not take advantage of the full power of these chips, which is the reason IBM and Microsoft teamed up to create a new operating system in the first place. Although machines with 286 and 386 chips make up less than 25 percent of the personal computers now in use, their popularity is on the rise. Last year they accounted for 48 percent of all personal-computer shipments, says John C. McCarthy of Forrester Research. He predicts that this figure will rise to nearly 75 percent this year, and to more than 80 percent in 1989. "OS/2 is going to be here a lot faster than many people think," says McCarthy.

Forrester expects OS/2 to emerge as the next operating-system standard for business computers as early as mid-1989. Other observers are not so optimistic, but there's little question that software will adopt OS/2 soon. A preliminary version of the system was released only last December, but by the end of 1987 Microsoft had shipped more than 4,000 OS/2 development kits—at \$3,000 each—to software publishers and corporate developers. The final version, which will include an interface

called Presentation Manager to make OS/2 software easier to use, won't be available until late this year.

By then, many companies will be ready with OS/2 programs, including the established giants of the personal-computer software industry. With their hordes of satisfied customers and well-honed sales networks, these companies will no doubt be heavyweights in OS/2 (see "Software Giants Cash In," p. 42).

But judging from the short history of personal-computer software, odds are that a handful of the new companies will elbow into top spots as a new software hierarchy forms around OS/2. It's too soon to predict which companies will make it; OS/2 creates a market open to all comers. "The most important products have come from left field, not really from the expected sources," notes Jonathan Rotenberg, president of the Boston Computer Society. Still, the proven development skills, strong management, and promising starts of Asymetrix, Blyth, Go, On Technology, and Micrografx push these companies to the front of the pack.

Although its effect is difficult to quantify, the presence of superstar software-writers in the OS/2 startup companies increases their chances of success, says David B. Readerman, vice president of research at securities analyst Smith Barney. Indeed, as this brain trust invests in OS/2, its sheer mental momentum may help ensure the system's success.

Perhaps no software company started in recent years has had as many luminaries as Go, founded last September with private funding. Kaplan, its president and CEO, is considered an expert in artificial intelligence. As chief scientist at Ashton-Tate, Go's vice president Carr developed Framework, a popular program that combines several applications. In addition, Lotus founder Kapor and Vinod Khosla, a co-founder of Sun Microsystems, sit on Go's board of directors.

Helping Kapor at On Technology, founded last November, is Peter B. Miller, formerly director of advanced technology at Lotus. As president, Miller will handle the business end while Kapor serves as the company's principal software designer. Kapor resigned as chairman of Lotus in 1986 so he could rediscover his roots in software development. As mentioned, Asymetrix is headed by Paul Allen, a founder of Microsoft.

With the talent clearly in place, suc-

WHAT WILL HAPPEN TO MS-DOS?

As the OS/2 operating system hits the market, the question of what will become of the ubiquitous MS-DOS system that preceded it is critical for companies that publish software for IBM PC-compatible computers. Sales of MS-DOS software are generally expected to level off this year and begin declining in 1989, though projections vary wildly as to how steep that decline will be.

Nevertheless, of the approximately 15 million IBM PCs and compatible computers atop U.S. desks, about 75 percent of them cannot run OS/2 without radical, expensive alterations. Millions more people are expected to buy lower-cost MS-DOS personal computers this year and next, despite OS/2. Therefore it seems unlikely that the market for DOS software will dry up immediately after the introduction of OS/2.

"DOS is not going to go away, at least not until the early 1990s," predicts Richard A. Shaffer, editor and publisher of the industry newsletter *Technologic Computer Letter*. "There are people out there still using the first release of WordStar and Lotus 1-2-3. They get the job done." Shaffer also points out that switching to OS/2 will be expensive, and businesses may balk at the cost of the hardware and software needed to adopt the new system.

In fact, software publishers who develop products solely for the DOS market may prosper for a time. In the rush to develop software for OS/2, larger companies may overlook the emergence of lucrative new DOS markets, says David B. Readerman, vice president of research at Smith Barney. This would leave room for smaller companies to develop new software for DOS.

cess for Asymetrix, Go, and On Technology hinges less on the names involved in them than on developing good products. "The corporate buyer is now educated to the point that he knows who these people are," says one industry observer. "That's enough to get these companies in the door, but it's not enough to make them successful. That depends on the product."

At this stage, the startups are saying little about product plans. But they seem to envision software that's more sophisticated than any programs currently on the market.

At Asymetrix, Allen intends to create software that takes a fresh approach to business needs. "We want to design software that works closer to the way people think about problems," says Allen, who is president and chairman of the privately held company. He calls the Asymetrix product, which should be released later this year or early in 1989, a high-end business program that combines elements from other programs such as database managers or word processors. "OS/2 gives us the opportunity to do software that pushes past the old boundaries," he says.

Despite the absence of details, Allen's venture has some apparent advantages. Asymetrix has a one- to two-year head start on most OS/2 developers; Allen founded it in 1985, anticipating the software opportunity created by the powerful 286 and 386 computers. Also, Asymetrix maintains a close working relationship with Microsoft, the company Allen helped start, and seems to be

scouting territory in a new software category with no direct competition.

However, Go may fill that competition gap. Like Asymetrix, Go is very vague about future products, but company statements sound similar to those from Asymetrix. Go plans to "pioneer new areas of computing rather than compete for market share with existing companies or products," says Kaplan. The company is developing a product for professionals and managers that won't be ready before next year.

Unlike Asymetrix and Go, On Tech-

nology is not wagering everything on OS/2. The company plans two similar classes of products, one for Apple Macintosh computers, the other for OS/2 machines. Nor is On Technology focusing on application programs, although Kapor says it may offer some. Instead, the company is developing software to fit between the operating system and the programs written for it. On Technology will sell these programs to other software companies, which will use them to write "a new class of personal, group, and public information sys-

Go

FOUNDED 1987

FINANCING Undisclosed amount from the venture firm Kleiner, Perkins, Caufield & Byers, and from directors Mitchell Kapor and Vinod Khosla

EMPLOYEES 10

PROPOSED OS/2 PRODUCT
Business software

STRATEGY To find and exploit an untapped niche in the crowded business-software market by creating personal-productivity programs.

139 Townsend
San Francisco, CA 94107
(415) 543-3200



S. Jerrold Kaplan, president

GEORGE STEINMETZ

SOFTWARE GIANTS CASH IN

If the OS/2 operating system opens a window of opportunity for small and upstart publishers of personal-computer software, it raises the roof of success for the industry's biggest and best-known companies. Software giants such as Microsoft, Lotus Development, and Ashton-Tate hope to match or better the fortunes they have made in products for the established MS-DOS system.

Not surprisingly, the largest publisher of personal-computer software, Microsoft, holds the most enviable position. It owns OS/2, and this \$395-per-copy product that it developed with IBM's help is expected to bring Microsoft enormous licensing revenues. What's more, Microsoft's Excel spreadsheet program is virtually ready to work with OS/2 and its Presentation Manager interface. This puts Microsoft in a position to challenge the dominance of Lotus 1-2-3 in the spreadsheet arena.

Lotus seems to have fewer obvious advantages. Its big money-maker, 1-2-3, must be completely rewritten to run under Presentation Manager, which would give the program the attractive, easy-to-use aspect that is expected to be a major benefit of OS/2. Lotus says it will introduce such a version, an update it calls 1-2-3/G, though how well the program adapts to the new graphic environment is open to question. Still, the durability of 1-2-3 has been un-

derestimated before; an elegant rendition of this famed spreadsheet for OS/2 may be enough to fend off competitors like Excel. OS/2 also gives Lotus another crack at exploiting new software segments, something it has done with little success in the DOS market.

By most reckonings, Ashton-Tate has a fight on its hands with OS/2. Not only will its venerable dBase program require a complete overhaul to run under Presentation Manager, but serious rivals are lining up to take a shot at unseating the database champ. OS/2 has the potential to make database software easier to use and more versatile, a combination many would-be competitors cannot resist. But like 1-2-3, the staying power of dBase has been underrated before. And like Lotus, Ashton-Tate can use OS/2 to diversify.

The immediate challenge for many software heavyweights—including Borland International, Software Publishing, Aldus, Microrim, and WordPerfect—is to capitalize on their success in the DOS marketplace with versions of familiar products that go a step further under OS/2. The long-term challenge, however, may be to create the type of innovative software that is the twinkle in the eye of the many entrepreneurs struggling to produce the OS/2 equivalent of a 1-2-3 or dBase.

tems," according to the company. Details are scanty, but it sounds as if Kapor wants to provide basic building blocks that programmers can combine into software that will offer free-form

filing procedures, letting people get at information much more easily.

Although Asymetrix, Go, and On Technology can expect to reap benefits from the reputations of their founders,

Micrografx

FOUNDED 1982

FINANCING About \$8 million 1987 revenue; \$16-\$20 million projected for 1988

EMPLOYEES 53

PROPOSED OS/2 PRODUCT

New versions of Designer, Graph, and Draw graphics packages

STRATEGY To use its Windows development experience to create OS/2 products for the fragmented graphics-software market.

1820 N. Greenville Ave.
Richardson, TX 75081
(800) 272-3729



Poul Groyson, chairman

Blyth and Micrografx enter the OS/2 arena with established DOS software that gives them footing in a particular niche. Of the two, Micrografx probably has the best position. The six-year-old company makes three products: Designer (formerly In*a*Vision), a drafting and illustration program; Windows Draw, a drawing and presentation-graphics package; and Windows Graph, a business program for creating charts from spreadsheet figures. All use the Microsoft Windows environment, a colorful program of pull-down menus and windows designed to give a computer the friendly look and feel of a Macintosh. When it is released by Microsoft in October, OS/2's Presentation Manager will be a close copy of Windows. Therefore, the few companies such as Micrografx that are programming with Windows have a head start in OS/2 software development.

Micrografx has sold about 100,000 copies of its software. This gives it a 5 percent share of the fragmented market for graphics software for personal computers. Its niche has been limited to people who use Windows, fewer than 10 percent of the personal-computer population. But now the com-

pany is preparing for rapid expansion as OS/2, with its built-in version of Windows, dramatically increases potential customers. "We've got established, mature products, and we feel we're properly positioned for a rapidly developing market," says president George Grayson, whose brother Paul is chairman and CEO of the privately held company. George Grayson expects Micrografx to become a \$20-million company this year, more than twice its present size. "We want to be a \$50-million company next year," he adds. "We can't do it without successful OS/2 products."

Micrografx hopes to garner a 40 percent share of the OS/2 graphics market. "We have the opportunity to literally take over the graphics field in the IBM PC world," says Grayson. To do this, Micrografx is revising its software and creating new packages. Grayson claims he will be ready with OS/2 versions of current products "within 24 hours" of the release of OS/2 and Presentation Manager in October.

This strategy of taking an early lead should help Micrografx. "The first company into a market category with a reasonably good product is successful," says Charles Wolf, vice president in the equities research department at First Boston. If this first-come, first-place relationship holds up, it will be hard for latecomers to displace the giants in the segments in which they are already established; an OS/2 version of Lotus 1-2-3, for example, would have a lot of clout. But so far, no clear leader has emerged in the graphics software market, despite the presence of big names such as Microsoft, Lotus Development, and Ashton-Tate. As long as Micrografx keeps its development lead, it has time on its side.

The greatest threat to Micrografx may well come from Microsoft, whose founder and leading Windows evangelist, Bill Gates, helped convince the Grayson brothers to write applications for Windows. Microsoft may offer its own graphics software when it releases the Presentation Manager interface. Such an introduction would seriously hamper the growth plans of Micrografx. However, the company's range of graphics products and its success thus far would probably sustain it, though perhaps at a scaled-down size.

Like Micrografx, Blyth Software hopes to parlay its current Microsoft

Blyth Software

FOUNDED 1984

FINANCING \$7 million from initial public offering, 1987

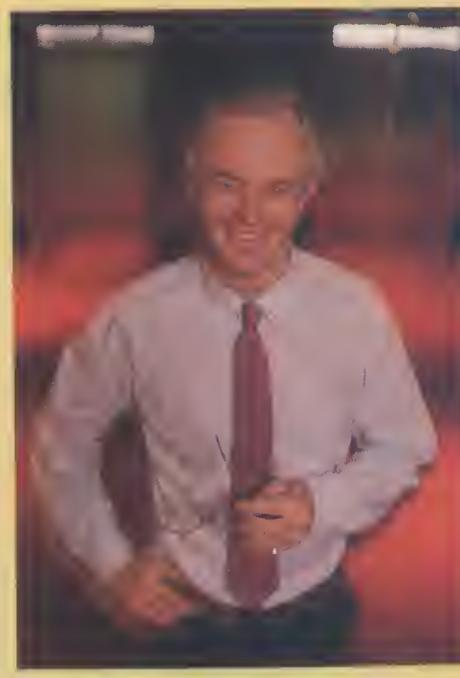
EMPLOYEES 45

PROPOSED OS/2 PRODUCT

New version of Omnis Quartz database

STRATEGY To use the smooth transition of Quartz from Windows to OS/2 to establish the product as a leader in database management.

1065 E. Hillsdale Blvd.
Foster City, CA 94404
(415) 571-0222



ED KASH

■ Michael Kenny, president

Windows software into OS/2 products. Blyth's recently introduced Omnis Quartz is the first high-end database program running under Windows, and will probably be one of the first database products for OS/2 as well.

Founded in 1984 as a subsidiary of Britain's Blyth Software, Blyth first published a database program for the Macintosh, an admittedly small niche. But Blyth did not want to compete against Ashton-Tate's best-selling dBase software, says president Michael Kenny. Much of Blyth's future prosperity depends on how Omnis Quartz fares in the OS/2 market. Quartz is a sophisticated product in the mold of Ashton-Tate's dBase III Plus, but its appearance and operation are more akin to Macintosh software, giving it a leg up on most DOS programs. The software's quick and easy adaptability to OS/2 also gives Blyth a development-time advantage over its competitors, according to Kenny.

Blyth plans to have an updated version of Quartz ready when the Presentation Manager edition of OS/2 comes out. "Our goal is to be a standard choice for high-end databases," says Kenny. It won't be easy: The established database suppliers, including Ashton-Tate and Microrim (which publishes R:base), have a lot more muscle. What's more, a number of small companies are work-

ing on sophisticated distributed databases. To gird for the looming market battle, Blyth went public last October to raise the cash it needs to strike early with a formidable product.

Kenny expects Blyth's revenues to double this year, and he hopes to double or triple the company's size in the next two years. To that end, he is opening sales offices around the country to pitch Blyth's products to *Fortune* 1,000 customers, especially those that are standardizing on OS/2 or using both IBM PC and Macintosh computers. "Our biggest challenge is to have the right infrastructure to take advantage of the opportunity before us," he says.

The enthusiasm with which Kenny and his counterparts at other upstarts are attacking the emerging market demonstrates the euphoria that greets the coming of most new technology opportunities. Some of the most celebrated minds in software have left the security of established companies to re-experience this kick of adrenalin. With any luck, their second opportunity will give the personal-computer world programs not yet imagined. ■

Christopher O'Malley is a free-lance writer who specializes in electronics and other technologies.

Siemens Capital President Hans Decker

ON BRINGING TECHNOLOGY TO THE UNITED STATES

GERMANY'S \$28-BILLION electronics giant Siemens AG has been operating in the United States since 1952. The U.S. segment has grown from \$500 million in 1980 to nearly \$3 billion in fiscal 1987, including a medical-equipment business that will top \$1 billion this year. After spending \$200 million to adapt its telephone central-office switch for the U.S. market, Siemens is poised to become the number-three supplier to the Bell operating companies behind AT&T and Canada's Northern Telecom. Other activities involve computers, automotive products, and power plants.

Siemens has almost \$10 billion in cash, so observers constantly watch for new moves into U.S. markets. Last year, the company completed its purchase of Telecom Plus, the largest U.S. distributor of telephone equipment, for about \$300 million, and speculation has surrounded possible interest in Allied-Signal's Bendix Electronics division.

Dr. Hans Decker has been president of Siemens Capital Corp., the holding company for U.S. operations, since 1971. HIGH TECHNOLOGY BUSINESS assistant managing editor Fredric Paul talked with him about Siemens' interest in the U.S. market.

■ *HT Business: How important is the U.S. market to Siemens?*

DECKER: This year, our U.S. revenues should be 10 to 12 percent of our total revenue, or maybe a little less. That

Dr. Hans Decker

Born: Sept. 10, 1929

Joined Siemens: 1958

Responsibilities:

Oversees financing, accounting, legal affairs, public relations, and personnel for all U.S. operations

U.S. revenue:

\$3 billion/year

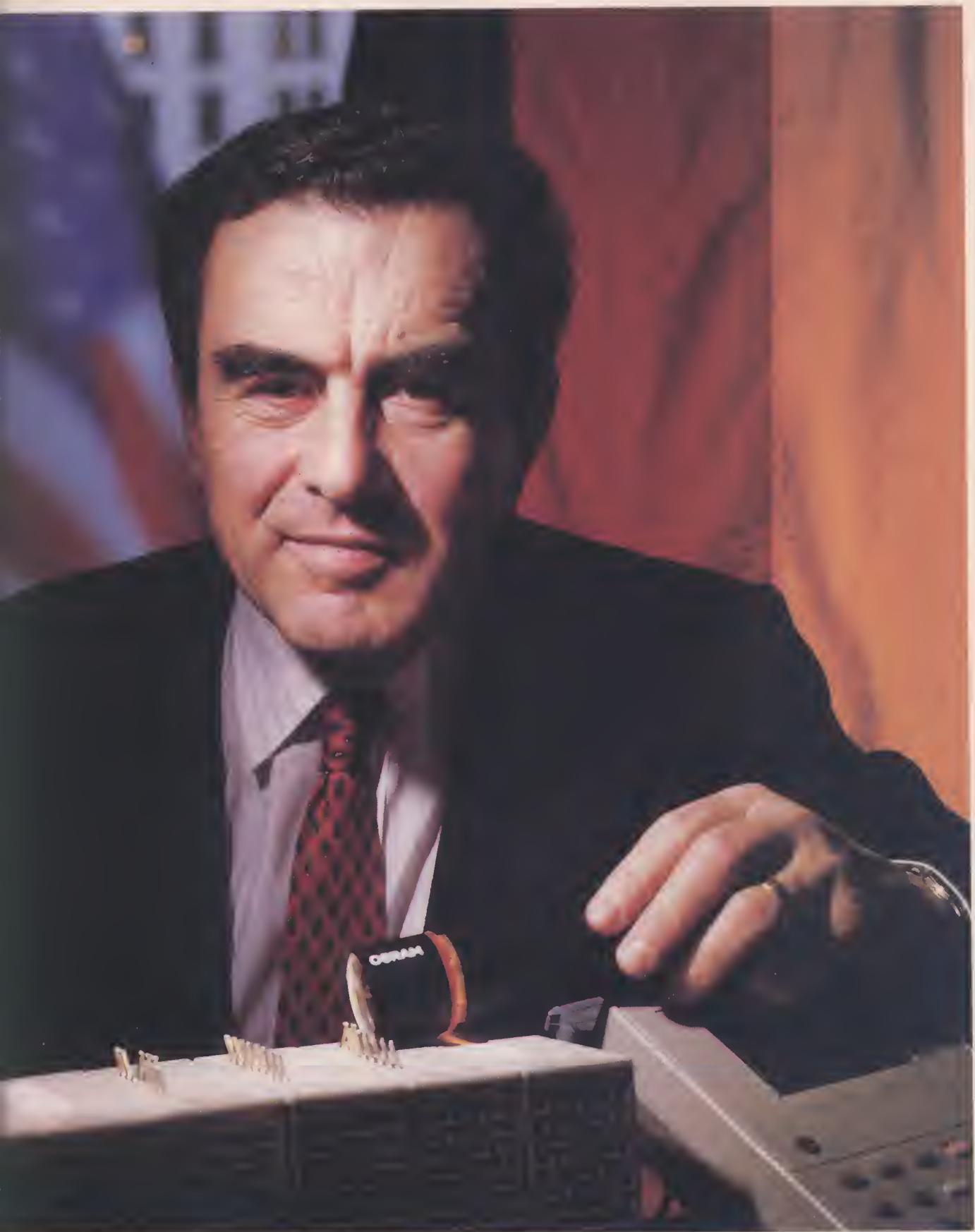
U.S. employees:

26,000

1987 U.S. R&D

budget: \$40 million





ROBERT WAGNER

might not sound like much, but this is by far our biggest market after West Germany, which is about 45 percent of our overall revenue.

The sheer size of the U.S. market is so intriguing that we think we have to be here. And, except for the medical-equipment business, our market share is so minute that it doesn't really count yet. So we have a long way to go—and if you start from zero you have a nice growth rate.

More important, the United States is a real testing ground; there is no other market as competitive. If you make it here, you establish your credentials for the rest of the world. This is a challenge we want to take up.

We also export from the United States. We export equipment, which is very important because there might be standards in some regions of the world that go by U.S. standards. But we also export know-how—we export to the rest of Siemens around the world the knowledge of how to do business in this market, which could apply to many other markets. Being an international group, doing business is not just a matter of selling equipment and sending an invoice—it's very much a matter of psychology. The fate of any big international group very much depends on how you manage to work together on a global scale. Across so many cultures and so many oceans, it's not easy.

How do you do it? There is no panacea, but one way is to make sure the company has more than one center of gravity. The psychology of working together in an international group works better when you have more than one of those centers. So we have a few in the United States, a few in Europe, and so on to make our world a more balanced place.

■ *HT Business: What do Siemens and other foreign companies bring to the U.S. market?*

DECKER: We bring in a new element of competition, especially where there are only two or three players in the domestic market. Also, in the capital goods, long-haul business, you have to be around for a long while, and we bring the mentality to do that.

■ *HT Business: Do most foreign companies have a longer perspective?*

DECKER: In Europe, and I might even say for the Japanese and others, there is a longer-haul view. One element of that is the mentality of the investor in Europe; it's drastically different from here. European investors are not as demanding, certainly in terms of timing. They don't look for quarterly reports, they don't look for up, up, up. They think if a company does good business and is there for the long haul and is profitable, that's fine, that's something. They wouldn't go in and out of a stock because the last two quarters were disappointing. And that kind of attitude makes a big difference in a company's outlook.

International experience is another element, and I think we bring that to bear. I also think business is more than just selling equipment. In most of our fields, customer relations are also personal relationships, because you deal with people over the longer term.

■ *HT Business: Are foreign companies operating in this country a positive force for the U.S. economy?*

DECKER: Yes, as a whole. I think it's good to the extent that we bring something valuable, either a quality product that might not be available otherwise, or good service.

■ *HT Business: How does U.S. technology compare with that of the rest of the world?*

DECKER: If you confine technology to research and development, then I guess the U.S. is at the top. If your definition includes manufacturing, quality, and delivery, other countries may be able to bring something to the party.

Manufacturing takes a certain mind-set. It takes people who are trained to do certain things and who want to achieve something. In manufacturing, the question is always, "Why are the Japanese good at what they're doing?" The Japanese are very good at teamwork, and everybody goes at it day and night. That brings out yield, and yield means cost advantage, and that means price advantage, and that's how they do it.

The Germans have a history of apprenticeship that goes back to medieval times. It takes two to three years and creates a certain loyalty to what you do, to your job, and maybe even to the company. It also imparts a certain discipline, and I think that goes a long way.

I don't want to be critical of U.S. manufacturers; the United States has very good ones and has improved greatly over the last two or three years. Everybody knows that. But there might be something lacking in terms of training.

■ *HT Business: How do multinational U.S. companies such as AT&T and IBM stack up in terms of overall competitiveness around the world?*

DECKER: You have to remember that, until recently, AT&T was a U.S. company for the U.S. market. It had to change into an internationalist overnight, and that sounds easier than it really is. Any international business requires a certain mind-set, whether it's export or international direct investment. You must have people on both sides of the ocean who understand that psychology. We have grown into that over decades, not just a year or two. So from an international point of view, though AT&T's products are tops, it has a harder time.

IBM is in a different league. It has been doing international business for I don't know how long, and I think it is as well versed internationally as it is domestically. It is the most formidable competitor the world over.

■ *HT Business: What part does politics play?*

DECKER: At Siemens, we've always said, "We do business, you do politics. These are two different worlds and they are nicely divorced." I've always had qualms about that—I wasn't sure they were so neatly divided. Now, we have seen they aren't. Washington didn't play a big role for us until about a year or two ago; now we know it plays a big role.

Business certainly does not occur in a vacuum. It occurs within a context, and one of the contexts is politics. In our telephone business, we had that episode where the FCC was getting on our back because of the French thing. [Siemens was contesting an AT&T deal to grab 16 percent of the French telephone-switching market, a deal that was eventually awarded to Sweden's L.M. Ericsson in what was seen as a political compromise.] That certainly got us on our toes.

■ *HT Business: Many Americans think overseas technology markets are not as open as U.S. markets. Is that perception correct? If so, what can U.S. companies do to cope?*

DECKER: The U.S. market is one of the most open markets in the world. There are hurdles and obstacles to this market, but they are market hurdles, market obstacles. I don't know

of any government-ordered requirements, except for a few local-content ordinances. But nothing on a mass scale to compare with other countries.

Outside the United States, there might be a few markets where you find unfair obstacles. If somebody is unfair, you have to do something maybe not fair to conquer it. I think there is no reason to just accept it.

But there are also market-given obstacles that you have to deal with. For instance, I was told—and I hope that it was not something that was just made up—that when AT&T was trying to sell some telecommunications equipment to the German Bundespost, it asked for the specifications in English. Now, when in Rome you have to do as the Romans do, you have to speak their language or at least have somebody that does so. You have to accommodate the normal and not unfair practices that go on anywhere.

■ *HT Business: Once you're in a market, how much local control is appropriate? For instance, how many Americans do you have in leadership positions here?*

DECKER: We have 26,000 people in the United States, and less than 150 are Germans. Of those 150, maybe half are service technicians and others who come and go.

Our policy is to have all of our operating units headed by an American, but it doesn't work all the time in all places. We do have that in place at our two biggest divisions. Only one senior officer is almost always a German, in many cases one who has been in the United States for many years, and that is the financial officer. We have to produce U.S. accounting numbers and also German accounting numbers, because the U.S. operation is part of the overall German company.

That's the extent of German management. In manufacturing there are certainly no Germans, and in marketing I would hope there are none. In research and development, maybe here and there we find a guy who is working with Americans, but that's it.

■ *HT Business: How do U.S. technological professionals compare with their German counterparts?*

DECKER: I haven't heard of any situation where we wouldn't get the people we need, as long as we pay the competitive price. But we do have to show Americans that they have a future with us. Germans ask, "What do I get as a pension in 40 years?" An American asks, "What is my career plan?"

■ *HT Business: What about manufacturing? Is it important to manufacture in the United States?*

DECKER: Very much so. To become a truly American supplier, an American vendor, we have to be manufacturers. It does not work if we import things from Germany. Second, our customers expect that. They don't want to contend with an offshore supplier knowing we can pack our stuff and leave tomorrow. Number three, on the currency side, we are much better off manufacturing here. Number four, it's better not to have every egg in the Siemens German nest in terms of manufacturing.

■ *HT Business: Is there pressure at home to keep the manufacturing in Germany?*

DECKER: Some, of course. The unions are not happy because we use up the export jobs. But they are right and not right at the same time. For a time, a few jobs are eliminated, but in the longer term there might not be any jobs left if we don't do international business.

■ *HT Business: What does the fall of the dollar mean to international companies?*

DECKER: Overall, it won't do that much to us. We have an 80 percent local content in what we do here, and we export from the United States as well, so we may even benefit a little bit. When you look closely at the various segments of our business, that's a different story. Those that import are somewhat hurt.

■ *HT Business: What about the stock market crash?*

DECKER: That would affect us only in indirect ways. If it triggers some kind of slowdown or even a recession, then we'll all be affected.

"The U.S. is a real testing ground. If you can make it here, you establish your credentials for the rest of the world."

I venture to say that most of the obstacles are not so much macroeconomic as microeconomic. These are things that companies can correct by themselves. If you want to enter a foreign market, you have to be willing to put out the money and play by their rules as long as they're not unfair.

■ *HT Business: What determines the best way to enter a foreign market, and what are the key steps?*

DECKER: I don't have an easy answer; it's case by case. There are many ways—through exporting, licensing, or direct investment. If you assume that you bring the technology, you look for two things: infrastructure and access to the market. It might be only a matter of timing that decides whether you try to do it on your own from scratch or through a joint venture or acquisition. Usually, acquisitions and joint ventures are quicker, but there are pitfalls.

For example, how do you integrate a new entity into your home company? Before you enter into a joint venture or an acquisition, you must have a plan for integrating the new enterprise. If you don't know how that integration is going to work, you should forget it. To do a venture or acquisition just for the sake of doing it is nonsense. It has to become part of your company, and that means hard, very cumbersome transitional work.

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■ OFFICE PRODUCTS



Displaymaker video-graphics system. A portable unit that produces color charts, graphics, and text for use in presentations. Images stored on floppy disk appear on TV displays, computer monitors, or video projectors. Made for people with no computer experience. \$1,995. Eastman Kodak Co., 343 State St., Rochester, NY 14650. (716) 724-3169. *Circle 1.*

1-2-3 networker. This version of 1-2-3 Release 2 links five personal computers at a time so users can share programs and files. A password prevents unauthorized access. \$2,475. Lotus Development Corp., 55 Cambridge Parkway, Cambridge, MA 02142. (617) 577-8500. *Circle 2.*

AGX System 1 workstation. A graphics station designed to produce slides. Has an 80286 processor, a 30-megabyte hard disk, and two megabytes of random-access memory. The product also includes software that provides 256 colors. \$29,850. Compugraphic, Box 9031, Waltham, MA 02154. (617) 890-8558. *Circle 3.*

Daily Routine software. Creates a daily agenda for salespeople, including call reports, follow-up activities, and customer-history files. The program also prints reports and mailing labels. It runs on IBM and compatible computers. \$175. First Phase Inc., Box 4504, Greensboro, NC 27404. (919) 855-8858. *Circle 4.*

Data 16 paper shredder. Destroys 16-inch forms as rapidly as 100 feet/minute. Takes 30 sheets at a time, reducing them to quarter-inch strips. Can handle single or continuous sheets. \$1,195. Michael Business Machines, 54-21 48th St., Maspeth, NY 11378. (718) 482-8610. *Circle 5.*

Data Receiver board. Transfers data from a non-IBM-compatible computer to an IBM PC/XT/AT or compatible unit. The board plugs into a standard expansion slot to accept data from Apple, TRS-80, Kaypro, and Heath-Zenith systems, as well as most CP/M computers. \$119. Image Technology Inc., 8150 S. Akron St., Suite 405, Englewood, CO 80112. (303) 799-6433. *Circle 6.*

Dips distributed optical system. Lets those who use 5 1/4- and 12-inch write-once, read-many (WORM) optical-disks capture and share images among personal computers in a local-area network. Runs on virtually any network, according to the company. \$30,000 to \$60,000. Optilan Corp., 4205 Sedge St., Fremont, CA 94555. (415) 471-1067. *Circle 7.*

Ektalite laser pointer. During presentations, this battery-powered pointer projects a red laser beam onto a screen as much as 150 feet away in normal room light. The hand-held device works with slides, overhead transparencies, video projections, and liquid-crystal displays. \$895. Eastman Kodak Co., 343 State St., Rochester, NY 14650. (716) 724-3169. *Circle 8.*

ES-1 toner cartridge. These units fit most photocopiers and laser printers, delivering 50 percent more copies than other cartridges, according to the company. Each cartridge produces at least 4,500 copies. \$99 to \$130. Laser Printer Products Inc., Box 506, Stoughton, MA 02072. (800) 521-7968; in Mass., (617) 341-3005. *Circle 9.*

FO-700 facsimile machine. Sends a page in 12 seconds, using a 16-step gray scale to reproduce half-tones. Stores 132 numbers and seven pages. Less than \$3,000. Sharp Electronics Corp., Sharp Plaza, Mahwah, NJ 07430. (201) 529-8950. *Circle 10.*

Inbox/PC software. Offers electronic mail and file transfer for IBM PC and compatible computers in local-area networks. It works while the computer performs other tasks. The software requires a file server that supports DOS 3.1 or later versions. \$559; \$99 for trial version. Symantec Corp., Think Technologies Div., 135 South Rd., Bedford, MA 01730. (800) 648-4465; in Mass., (617) 275-4800. *Circle 11.*

K-2+ page printer. Delivers 15 pages/minute with 300-dot/inch resolution. In-

cludes a 550-sheet primary tray and a 250-sheet secondary tray, RS-232C and RS-422 serial interfaces, and a Centronics parallel port. Emulates the Hewlett-Packard LaserJet Plus. \$8,970. Kentek Information Systems Inc., 6 Pearl Court, Allendale, NJ 07401. (201) 825-8500. *Circle 12.*

Lantastic local-area network. This software for the IBM PC works with such networks as Novell, IBM, and Tapestry. \$199 per network station. Artisoft Inc., 3550 North 1st Ave., Suite 330, Tucson, AZ 85719. (602) 293-6363. *Circle 13.*

Laserprinter 8 printer. Produces eight pages/minute. It has one megabyte of random-access memory to print text and graphics with 300×300-dot/inch resolution. Emulates the Hewlett-Packard LaserJet Plus, Diablo 630, Epson EX-800, and IBM ProPrinter. \$2,699. Star Micronics Inc., 200 Park Ave., Suite 3510, New York, NY 10166. (212) 986-6770. *Circle 14.*

MessageNet PC transfer software. Lets personal-computer users send messages and files to DEC VAX minicomputers and personal computers. Automates data communication so users need only specify the recipient's name, the transmission route, and time. \$185. S&H Systems Inc., 1027 17th Ave. South, Nashville, TN 37212. (615) 327-3670. *Circle 15.*

Microcom network bridge. A transparent bridge that passes data packets from one local-area network to another. Includes a built-in modem and software that connects Ethernet or token-ring networks over telephone lines. \$7,499 to \$8,999. Microcom Inc., 1400 Providence Highway, Norwood, MA 02062. (617) 762-9310. *Circle 16.*

MultiModem 3270 emulator. A communications device that lets IBM-compatible personal computers connect to IBM mainframes; the personal computers operate on IBM SNA networks as if they were SNA terminals. Includes a Bell 208/201C-compatible modem card. \$1,495. Multi-Tech Systems Inc., 82 Second Ave. S.E., New Brighton, MN 55112. (800) 328-9717; in Minn., (612) 631-3550. *Circle 17.*

NR-10 dot-matrix printer. Uses a 10-inch carriage to print 240 characters/second for draft quality, 60 characters/second for near letter quality. Works with most microcom-

NEW PRODUCTS

puters; includes a parallel interface and emulates the Epson FX Series, IBM Graphics Printer, and IBM Proprinter. \$549. Star Micronics Inc., 200 Park Ave. South, Suite 3510, New York, NY 10166. (212) 986-6770. *Circle 18.*

On Schedule planning software. This package lets people create custom schedules, break them down into manageable steps, track progress, and monitor assignments. The software runs on IBM PC/XT/AT computers with DOS 2.0 or a later version. \$89.95. Caddylak Systems Inc., Dept. PZ, 60 Shames Dr., Westbury, NY 11590. (516) 333-7440. *Circle 19.*

Power Desk software. To help organize office tasks, this software includes a word processor, a spelling checker, a name-and-address database, and a calendar/reminder system, plus a calculator and timekeeper. Produces letters, labels, envelopes, and index cards; runs on IBM-compatible personal computers. \$99. Software Studios Inc., 8516 Sugarbush, Suite 104, Annandale, VA 22003. (800) 272-3375; in Va., (703) 978-2339. *Circle 20.*

R2100 facsimile machine. A virtual fax machine that communicates through private networks as well as over conventional telephone lines. The product connects IBM PC/AT/XT computers that run Ricoh software and have a Ricoh fax modem card. \$4,999. Ricoh Corp., 5 Dedrick Place, West Caldwell, NJ 07006. (201) 882-2000. *Circle 21.*

SP personal computer. Has an 80386 processor to run at 4.77 to 16 megahertz. The computer stores two megabytes in random-access memory (expandable to eight megabytes) and has a 5½-inch disk drive and a 30-megabyte hard disk. Includes five expansion slots, plus serial and parallel ports. From \$5,880. Honeywell Bull Inc., 300 Concord Rd., Billerica, MA 01821. (617) 671-2517. *Circle 22.*

Theos operating system. This operating system lets six people perform multiple tasks on one IBM Personal System/2 Model 80, all at the same time. The system provides as much as 16 megabytes of memory. In addition, the system supports such capabilities as electronic mail, file- and record-locking security, and business graphics. From \$695. Theos Software Corp., 1777 Botelho Dr., Suite 360, Walnut Creek, CA 94596. (415) 935-1118. *Circle 23.*

Video Professor training tapes. These instructional videotapes use computer animation, split screens, and scripts written by industry experts to train people to use common word-processing and business software. Available programs include WordPerfect, 1-2-3, dBase III Plus, Wordstar Professional, Microsoft Word, and DOS. Students proceed at their own pace and practice on a personal computer. Each tape is 45 to 90 min-

utes long. \$79.95. Data Link Research Services Inc., 1536 Cole Blvd., Suite 180, Golden, CO 80401. (800) 225-7798. *Circle 24.*

inch analog monitor offers three resolution settings—640×350, 720×400, and 640×480 pixels—and also features a tilt-and-swivel base. \$639. Quimax Systems Inc., 844 Del Rey Ave., Sunnyvale, CA 94086. (408) 773-8282. *Circle 29.*

G80-2000 keyboard. Works with the IBM PC/XT/AT and compatible computers. Has 123 keys, 24 of them programmable, plus bar-code and magnetic-card readers. The keyboard also contains software to emulate Microsoft, Summagraphics, and Genius programs. \$1,005. Cherry Electrical Products, 3600 Sunset Ave., Waukegan, IL 60687. (312) 360-3500. *Circle 30.*

Master Piece 400 power center. This device replaces the power cord on personal computers in which the central processing unit stands beside the desk, such as the IBM PS/2 Models 60 and 80. The device provides three extra outlets and controls power surges, interference, and static. \$99.95. Kensington Microware Ltd., 251 Park Ave. South, New York, NY 10010. (212) 475-5200. *Circle 31.*

Model 280 color display. This monitor offers a 14-inch screen with a 25×80-line or 132-column display. It shows 64 colors simultaneously and stores four pages. The display also has 16 programmable function keys and 6,000 bytes of nonvolatile memory. \$1,095. Ampex Corp., 401 Broadway, Redwood City, CA 94063. (415) 367-4151. *Circle 32.*

Mono-Master/Plus graphics board. Makes the IBM PC/XT/AT compatible with Hercules monochrome graphics, for 720×348-pixel resolution. The board has 25-pin serial and parallel ports, a clock/calendar, and 64 kilobytes of video memory. \$199. Boca Research, 6401 Congress Ave., Boca Raton, FL 33487. (305) 997-6227. *Circle 33.*

PQ-5211 printer interface. Lets IBM printers work with IBM's newer System 36 computers; the interface increases print speed by as much as 20 percent. \$2,995. Black Box Corp., Box 12800, Pittsburgh, PA 15241. (412) 746-5500. *Circle 34.*

Spectrasync 1550+ color monitor. The 15-inch flat screen offers a graphics resolution of 1,024 pixels × 800 lines. Works with the IBM PS/2, the IBM PC/AT, and the Apple Macintosh II computers. A mode switch lets users select 8, 16, or 64 colors to suit the installed graphics card. \$1,299. Idek America Inc., 204 S. Olive St., Rolla, MO 65401. (314) 364-7500. *Circle 35.*

Viking 2400 24-inch monitor. Displays two legal-size pages, engineering drawings, or a 134×68-cell spreadsheet. The monochrome monitor offers 1280×960-pixel resolution and works with IBM PCs, the PS/2, and the Apple Macintosh II or SE. \$2,995. Moniterm, 5740 Green Circle Dr., Minnetonka, MN 55343. (612) 935-4151. *Circle 36.*

COMPUTER HARDWARE



Ultrasync color monitor. A 12-inch monitor compatible with the IBM PC/XT/AT as well as the new PS/2 VGA standard; also works with the Apple Macintosh II. Resolution is 800×600 pixels. The monitor offers an analog mode and 8, 16, or 64 colors in TTL mode. Users can switch between green and amber displays. \$795. Princeton Graphic Systems, 601 Ewing St., Building A, Princeton, NJ 08540. (800) 221-1490; in N.J., (609) 683-1660. *Circle 25.*

Courier 2400e/PS modem board. Fits in any IBM PS/2 Model 50, 60, or 80 Micro Channel expansion slot to handle communications at 2,400, 1,200, or 300 bits/second. Operates as fast as 4,800 bits/second by using data compression; includes error-control protocols. \$699. US Robotics Inc., 8100 N. McCormick Blvd., Skokie, IL 60076. (312) 982-5010. *Circle 26.*

CS 5000 personal computer. This IBM PC/AT-compatible unit has an 80386 processor and runs at 16 megahertz. It has two megabytes of random-access memory that can be increased to eight megabytes, plus a 1.2-megabyte disk drive and a 40-megabyte hard disk. Includes six expansion slots and three ports. Price not available. Cordata Technologies Inc., 1055 W. Victoria St., Compton, CA 90220. (213) 774-1746. *Circle 27.*

Deskjet ink-jet printer. A desktop unit providing near laser quality—300×300-dot/inch resolution—to print text and graphics at two pages/minute. Includes serial and parallel interfaces; compatible with most H-P LaserJet software. \$995. Hewlett-Packard Co., 1820 Embarcadero Rd., Palo Alto, CA 94303. Call local sales office. *Circle 28.*

DM-3112 color monitor. A display monitor made to work with the IBM PS/2 and most IBM-compatible computers. The 12-

■ NEW PRODUCTS ■

■ COMPUTER SOFTWARE

@Base database for 1-2-3. Lets people create, access, and maintain a disk-based database that works with dBase III and dBase III Plus. The relational database can be used as an extension of Lotus 1-2-3, or as a separate transaction-processing system. This product runs on the IBM PC/XT/AT, PS/2, and compatible computers. \$195. Personics Corp., 2352 Main St., Concord, MA 01742. (617) 897-1575. *Circle 37.*

Concordance text retriever. Finds files based on such factors as key phrases, dates, or numbers. Works with the IBM PC/XT/AT, PS/2, and compatible computers running DOS 2.0 or later versions. \$595. Dataflight Software, 10573 W. Pico Blvd., Suite 68, Los Angeles, CA 90064. (213) 785-0623. *Circle 38.*

FreeHand drawing program. Helps Macintosh II/Plus/SE users create or trace graphics, manipulate text, and scale, rotate, reflect, and skew objects. The program supports color separations and four process colors, plus tints on the Macintosh color monitor. Works in graphics files created with the Adobe Illustrator program. \$495. Aldus Corp., 411 First Ave. South, Suite 200, Seattle, WA 98104. (206) 628-2352. *Circle 39.*

GamePlan expert system. Simulates an organization's response to actions taken by information-systems managers. The program lets managers select a corporate culture, then shows the results of various decisions. Runs on MS-DOS or PC-DOS personal computers. \$495. N. Dean Meyer & Associates Inc., 233 Mountain Rd., Ridgefield, CT 06877. (203) 431-0029. *Circle 40.*

Help System instructor. This software eases the transition from the WordStar word-processing program to WordPerfect. It resides in the memory of the user's personal computer to translate WordStar commands into WordPerfect functions, and provides feedback and help. \$95. Imsatt Corp., 500 N. Washington Street, Falls Church, VA 22046. (703) 533-7500. *Circle 41.*

Interleaf Publisher desktop publisher. Written for the Apple Macintosh II, this software lets users integrate text and graphics. The package accommodates documents hundreds of pages long and automatically re-paginates and reformats documents in response to editing changes. Requires five megabytes of random-access memory and a 40-megabyte hard disk. \$2,495. Interleaf Inc., 10 Canal Park, Cambridge, MA 02141. (617) 577-9800. *Circle 42.*

Kanji PageMaker desktop publisher. Version 2.0 lets small publishers work with Japanese and English text and graphics. Runs on the Macintosh Plus/SE/II with a hard disk or 800-kilobyte disk drives and re-

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NEW PRODUCTS

quires a LaserWriter or Image Writer printer. Price not available. Aldus Corp., 411 First Ave. South, Suite 200, Seattle, WA 98104. (206) 628-2352. *Circle 43.*

Pageview previewer. This program lets Microsoft Word users look at documents on screen before printing them. Users also can add graphics to documents with Windows 2.0 or Windows/386. Runs on the IBM PC and compatible computers, as well as the IBM PS/2. \$49.95. Microsoft Corp., 16011 N.E. 36th Way, Redmond, WA 98073. (206) 882-8080. *Circle 44.*

Snapshot capture program. Takes images from any video source and lets users manipulate them with such effects as mirroring, painting, and conversion to line drawings. The program works in the IBM PC/AT-based Microsoft Windows environment and requires 512 kilobytes of random-access memory as well as an image-processing board. \$495. Aldus Corp., 411 First Ave. South, Suite 200, Seattle, WA 98104. (206) 628-2352. *Circle 45.*

Stop/Go decision analyzer. Lets business people examine 70 factors in 13 categories to assess a venture's chances of success. The software also identifies strengths and weaknesses and presents results as tables and graphs. \$195. Suntex National Corp., Box 772868, Houston, TX 77215. (713) 783-9059. *Circle 46.*

VenturPlan business planner. Helps develop plans for executives starting small-to-medium-sized retail businesses. Covers goals, timetables, strategies, policies, and finances. \$495. Venture Software Inc., 222 Third Street, Cambridge, MA 02142. (617) 491-6156. *Circle 47.*

Wendin-DOS operating system. This replacement for MS-DOS runs on the IBM PC/XT/AT and 80386-based personal computers that have 512 kilobytes of random-access memory. The system accommodates multiple users and tasks, working with such programs as WordPerfect, Lotus 1-2-3, DBase III Plus, and RBase 5000. \$99. Wendin Inc., Box 3888, Spokane, WA 99220. (509) 624-8088. *Circle 48.*

WinGraph business-graph maker. Generates charts and graphs from numerical data, running in the Microsoft Windows environment. Images can be displayed in sequence, as in a slide show. \$195. Palantir, 12777 Jones Rd., Suite 100, Houston, TX 77070. (713) 955-8880. *Circle 49.*

Works business software. Combines a word processor, spreadsheet, database, and communications program. Works with IBM PC-compatible computers and the PS/2. The package requires a CGA, EGA, or Hercules graphics card. \$195. Microsoft Corp., 16011 N.E. 36th Way, Redmond, WA 98073. (206) 882-8080. *Circle 50.*

COMMERCIAL/INDUSTRIAL

66032/42 mechanical power meters. These units measure and display torque and speed, head and flow, or force and velocity. Model 66032 has a switched display with automatic scanning; Model 66042 has two dedicated displays to simultaneously show torque, speed, and power. \$2,780 and \$3,250, respectively. S. Himmelstein and Company, 2490 Pembroke Ave., Hoffman Estates, IL 60195. (312) 843-3300. *Circle 51.*

BusTrak bus analyzer. Includes logic analyzers, code debuggers, and testers to read 8,000 to 32,000 bus states in real time. Triggers include address or address range, data bus, I/O or memory access, reads or writes, interrupts or direct-memory-access requests, or any combination thereof. \$1,500 to \$2,500. Applied Physics, 1291 E. Cumberland Ave., West Lafayette, IN 47906. (317) 497-1718. *Circle 52.*

Checkprinter banking printer. Produces checks and other documents for companies, freeing them from dependence on the check-printing services of banks. Prints Magnetic Ink Character Recognition (MICR) code. \$146,400. Ramstar, 222 Agricultural Bldg., The Embarcadero, San Francisco, CA 94056. (415) 362-1525. *Circle 53.*

CT-150 printer/terminal tester. Checks and exercises most terminal and printer devices when they are off line; does not need a computer. Includes a 32-character liquid-crystal display, two serial ports, one parallel port, and a monitor port. \$995. Decitek Test Systems Inc., 25 South St., Hopkinton, MA 01748. (617) 435-6931. *Circle 54.*

DataTalker plain-English interface. This software package lets users of IBM RT personal-computer workstations get a variety of corporate information out of relational databases, using plain-English commands. From \$10,000. Natural Language Inc., 1786 Fifth St., Berkeley, CA 94710. (415) 841-3500. *Circle 55.*

Designer Graphics RV graphics system. Lets technical illustrators use raster and vector images in the same frame. Users can transfer drawings from computer-aided design systems, then revise and annotate them with text. The system also permits free-hand drawing of geometric shapes and manipulation of scanned, half-tone images. \$9,900. Intran Corp., 5601 Smetana Dr., Minnetonka, MN 55343. (612) 931-9170. *Circle 56.*

Drawbase 2000 CAD program. A 2-D computer-aided-design program that includes construction geometry, an interrupt command structure, and DXF import/export capability. The program is copy protected. \$1,995. Skok Systems Inc., 222 Third Street, Cambridge, MA 02142. (617) 868-6003. *Circle 57.*

Drawbase 4000 CAD package. Integrates 2-D drafting and database management. Includes the Space Accounting program, which tracks the area and perimeter values of drawn objects. \$3,995. Skok Systems Inc., 222 Third St., Cambridge, MA 02142. (617) 868-6003. *Circle 58.*

Eagle 16S0/1680 scanners. Accepts documents 1 to 17 inches wide, scanning line drawings for conversion into data for computer-aided design systems. Model 1650 scans quickly at lower resolutions; Model 1680 scans more slowly for higher quality. \$45,000 and \$50,000, respectively. Ana Tech Corp., 10499 Bradford Rd., Littleton, CO 80127. (303) 973-6722. *Circle 59.*

Metamorphosis translator. Converts programs from one computer language to another. This program comes in generic form, or preconfigured to translate a specific language. The translator runs on the IBM PC/XT/AT or compatible computers that have at least 384 kilobytes of random-access memory. \$387 for the generic version; \$1,434 pre-configured. Shannon Associates Inc., Box 597, Chapel Hill, NC 27514. (919) 929-6863. *Circle 60.*

MX-240 color graphics monitor. For computer-aided design and engineering, this 19-inch monitor offers a 200-megahertz video bandwidth, guaranteed brightness of 40 to 55 footlamberts, and 1,600×1,280-pixel resolution. Users can specify scan rates of 40 to 90 kilohertz horizontal and 45 to 90 hertz vertical. Retracing takes 3.0 microseconds. From \$6,995. Monitronix Corp., 929 Eastwind Dr., Suite 220, Westerville, OH 43081. (614) 891-3232. *Circle 61.*

Proscan Model 840 scanner. Works with publishing systems that use the host computer for image processing. The scanner has a resolution of 400 dots/inch at 256 gray levels and includes a Small Computer Systems Interface (SCSI). Scan area measures 8½×11 inches. \$4,800. Datacopy, 1215 Terra Bella Ave., Mountain View, CA 94043. (415) 965-7900. *Circle 62.*

QuikInfo conversion program. For engineers, technicians, and scientists; converts a number into the equivalent unit of another measurement system. Works concurrently with database, spreadsheet, or other software on IBM-compatible personal computers. \$49. Plies Development Corp., 2110 Crystal Hills, Houston, TX 77077. (713) 493-3679. *Circle 63.*

Salespoint inventory system. This software for IBM-compatible personal computers prints point-of-sale invoices and purchase orders, managing inventory and tracking warranty information. It also generates price quotes, back orders, and work orders, and handles commissions. \$1,995. SSR Corp., 1600 Lyell Ave., Rochester, NY 14606. (800) 521-0142. *Circle 64.*

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Secureline phone encrypter. Encodes voice and data telephone transmissions for security. The desktop unit fits in a briefcase. From \$1,500. CCS Communication Control Inc., 160 Midland Ave, Port Chester, NY 10573. (914) 934-8100. *Circle 65.*

SmartModel simulation software. Lets system designers using Motorola MC68030 processors verify the operation of integrated circuits before building physical prototypes. The software automatically finds system design errors. A workstation license costs \$2,400, or \$12,900 as part of a Motorola microprocessor model package. Logic Automation, 19500 N.W. Gibbs Dr., Beaverton, OR 97006. (503) 690-6900. *Circle 66.*

Tape-to-Shape code interpreter. This software reads machine-tool computer-numeric-control programs stored on punched tape or electronic media, then converts the data to part geometries. These geometries work in the company's SmartCAM computer-aided design/manufacturing system, or can be converted for use in other systems. \$3,000. Point Control, 2468 W. 11th Ave., Eugene, OR 97402. (503) 344-4470. *Circle 67.*

Epo-Tek 11S-SMT epoxy adhesive. A solventless epoxy for attaching surface-mount devices before wave-soldering. Curing takes 30 minutes at 80 degrees Centigrade. No change after a 30-minute soak in freon at room temperature, according to the company. \$27 for a 3-ounce trial kit. Epoxy Technology Inc., 14 Fortune Dr., Billerica, MA 01821. (617) 667-3805. *Circle 72.*

KSY 20 Hall-effect generator. This gallium-arsenide device uses two sensors to determine the position of metal objects. It comes in a surface-mount package and withstands -40 to 150 degrees Centigrade. \$15.60 each in lots of 100. Siemens Components Inc., Special Products Division, 186 Wood Ave. South, Iselin, NJ 08830. (201) 321-3400. *Circle 73.*

Surface-mount varistors. These metal-oxide varistors have peak pulse-current ratings of 1,200 amps and energy ratings of 25 Joules. The devices operate from 4 to 300 volts AC and are symmetrical for mounting in any orientation. They come in 26 types, three sizes, and two package styles. Less than 50 cents each in lots of 5,000. Siemens Components Inc., Special Products Division, 186 Wood Ave. South, Iselin, NJ 08830. (201) 321-3400. *Circle 74.*

TLPS90/591 photovoltaic coupler. Consists of a gallium-arsenide infrared-emitting diode optically coupled to a photo-diode array. The device drives power MOSFETs and does not need an external power source. \$2 each in lots of 1,000. Toshiba America Inc., Semiconductor Products Division, 2692 Dow Ave., Tustin, CA 92680. (714) 832-6300. *Circle 75.*

■ MANUFACTURING SUPPLIES

AD652 converter. Converts voltage to frequency; does a 16-bit analog-to-digital conversion in 32.77 milliseconds. Nonlinearity is ± 0.005 percent. \$6.95 each in lots of 100. Analog Devices, Box 9106, Norwood, MA 02062. (617) 329-4700. *Circle 68.*

Additions to analog-cell library. These cells let designers combine analog and digital functions on one integrated circuit. The additions include two comparators, three op amps, a voltage reference, an analog switch, and resistors; all work with five-volt power supplies. Price varies with circuit and design time. National Semiconductor, Box 58090, Santa Clara, CA 95052. (408) 749-7431. *Circle 69.*

A-Pak resin packaging film. Each two-part flexible pouch contains premeasured amounts of unmixed resin and catalyst. The particle-free resin is easily activated and dispensed to seal packages without contamination. Custom packaging available. \$.50 to \$2.50. Adhesive Packaging Specialties Inc., Box 31, Peabody, MA 01960. (617) 531-3300. *Circle 70.*

Deposition Grade tungsten hexafluoride. When used in semiconductor manufacturing, this gas has metallic impurities of less than 0.5 parts/million. Packaged in a pure-nickel container. \$1,300 to \$1,500 per pound. Air Products and Chemicals Inc., Box 538, Allentown, PA 18105. (215) 481-4520. *Circle 71.*

Audio and video connectors. Many types of adapters, cables, and patch cords to connect equipment. \$2.49 to \$29.99. Sony Corporation of America, Sony Drive, Park Ridge, NJ 07656. (800) 222-7669. *Circle 79.*

Dual-purpose CD player. Reads as much as 540 megabytes of data or music—the equivalent of about 1,000 floppy disks. Connects to Atari's ST and Mega computers through the direct-memory-access channel. Price not available. Atari Corp., 1196 Borregas Ave., Sunnyvale, CA 94088. (408) 745-2000. *Circle 80.*

Earl Weaver Baseball game. A computer program that simulates baseball action and strategy; co-authored by former Baltimore Orioles manager Earl Weaver. \$49.95. Electronic Arts, 1820 Gateway Dr., San Mateo, CA 94404. (415) 571-7171. *Circle 81.*

Graphics Studio software. A paint-and-drawing animation program for the Apple IIGS and Commodore Amiga home computers. \$59.95 and \$69.95. Accolade, 20813 Stevens Creek Blvd., Cupertino, CA 95014. (408) 446-5757. *Circle 82.*

Headphones. Three types: Model MDR-CD6 is made for compact-disc players and monitors digital music sources. The lightweight Series S phones cover the entire ear. The MDR-A60 fashion headphones fit vertical to the ear and come in various colors. \$24.95 to \$119.95. Sony Corporation of America, Sony Drive, Park Ridge, NJ 07656. (800) 222-7669. *Circle 83.*

Keepsafer home-security system. Includes a control console and transmitter/sensor set; arms or disarms by remote control. Accessories include an automatic dialer that contacts a 24-hour center; the center monitors calls and alerts the appropriate authorities. \$99; \$15 per month for the 24-hour call service. Schlage, 2401 Bayshore Blvd., San Francisco, CA 94134. *Circle 84.*

■ CONSUMER PRODUCTS

9970RT car radio/cassette player. Automatically scans preset radio stations; also automatically finds the next station signal when a signal fades during travel. \$699.95. Clarion Corporation of America, 5500 Rosecrans Ave., Lawndale, CA 90260. (213) 973-1100. *Circle 76.*

AM-93 integrated amplifier. Has two digital-to-analog converters to handle inputs from two digital-audio-tape decks, a compact-disc player, and a play-only digital source. Price not available. Akai, 225 Old New Brunswick Rd., Piscataway, NJ 08854. (201) 562-8500. *Circle 77.*

AT-93 AM/FM stereo tuner. Compensates for weak radio signals; has an open-loop DC amplifier and a separate power supply for the audio section. Stores station locations in memory. Price not available. Akai, 225 Old New Brunswick Rd., Piscataway, NJ 08854. (201) 562-8500. *Circle 78.*

Portable typewriters. Five models offer such features as letter-quality printing in three type sizes, lift-off word correction, abbreviation storage, and a spelling checker. \$199.95 to \$329.95. Sharp Electronics, Personal Home Office Electronics Div., Mahwah, NJ 07430. (201) 529-8872. *Circle 85.*

Test Drive driving simulator. This software provides the feel of driving such sports cars as the Ferrari Testarossa, the Lamborghini Countach, and the Lotus Esprit Turbo. Runs on IBM PC, Atari ST, Commodore Amiga, and Commodore 64/128 computers. \$29.95 to \$44.95. Accolade Inc., 20813 Stevens Creek Blvd., Cupertino, CA 95014. (408) 446-5757. *Circle 86.*

VIP video processor. Boosts the detail of video images without creating visual side-effects. \$199. Multivision, 1751 Fox Dr., San Jose, CA 95131. (408) 947-8877. *Circle 87.*

MARKET WATCH

NEW COMPANIES

COMPANY (STOCK SYMBOL)	BUSINESS OBJECTIVE	FINANCING	OFFICERS	OFFICERS' PREVIOUS POSTS
Cree Research 2100 W. Park Dr. Res. Triangle Park, NC 27713 (919) 361-5709	To build silicon-carbide-based semiconductors for aerospace, drilling, automotive, and electronics markets.	\$500,000 from a private investor	Eric Hunter, president Calvin Carter, dir. of technology	MKS Instruments, district sales mgr. N.C. State University, prof. materials & engineering
Cycomm 6665 S.W. Hampton Portland, OR 97223 (503) 620-1024	To make and market voice- and data-encryption equipment.	\$3 million from venture capitalists	Gordon T. Collett, president, CEO Carlos Bofill, v.p. sales and marketing	Teneron, founder, v.p. engineering California Microwave, v.p. sales and marketing
Focus Homecare 701 94th Ave. N. St. Petersburg, FL 33702 (305) 576-6851	To provide respirators and other medical equipment to homebound patients.	\$50 million from GE Credit Corp.	James T. Kelly, president	Linde Homecare, president
Integrated Analytics 13101 Washington Blvd. Los Angeles, CA 90066 (213) 578-5052	To develop artificial-intelligence systems for the financial service and securities industry.	\$800,000 from contracts	Dale A. Prouty, president Peter Hollings, exec. v.p. David Leinweber, chief scientist	Inference, sr. scientist Pointe Webber, v.p. Rand, sr. scientist
MacroMind Productions 1028 W. Wolfram Chicago, IL 60657 (312) 871-0987	To produce animated programs for corporate presentations, trade-show exhibits, and product displays.	Undisclosed amount from parent company, MacroMind Inc.	Marc Conter, founder, president	MacroMind, founder, president (current)
Network Management 11242 Waples Mill Rd. Fairfax, VA 22030 (703) 385-4774	To serve as a holding company for network-management companies it acquires.	\$12.7 million from venture capitalists	Howard Frank, CEO Michael Muntner, president	Howard Frank Associates, president Contel Government Systems Div., president
Neurex 1500 Salado Dr. Mountain View, CA 94043 (415) 961-8400	To develop therapeutic neuropharmaceutical products.	Almost \$6 million in first-round financing	Thomas Bartan, CEO, acting president Jomakiroman Ramachandran, v.p. research	Hartzman, Wise, Shepard, principal (current) Genentech, researcher
N. Amer. Components & Equip. 2 Gourmet Lane Edison, NJ 08837 (201) 549-7990	To provide value-added procurement and marketing services to overseas clients.	Several million dollars from commercial banking	Kenneth Shiloff, president Victor Vaiti, v.p.	ITT N. American Sourcing Div., managing dir. ITT Data Equipment & Systems, president, CEO
TCom Systems 2001 L Street N.W. Washington, D.C. 20036 (202) 775-0095	To provide an enhanced electronic-distribution service for first-class mail.	\$15 million from venture capitalists	Rabert Ryon, CEO	DialCam International, chairman, CEO, president
Teleos 2 Meridian Rd. Eatontown, NJ 07724 (201) 389-5700	To build integrated systems digital network (ISDN) products for original-equipment manufacturers, end users, and suppliers.	Undisclosed amount from venture capitalists	Charles Bass, chairman, CEO Tibor Szekeres, founder, v.p. engineering	Ungermon & Bass, co-founder Bell Laboratories, engineering manager
Viogene 11180 Roselle St. San Diego, CA 92121 (619) 546-8300	To discover, develop, and commercialize therapeutic drugs using flexible gene delivery technology.	\$1 million from Domain and Biotechnology Investments	David Hale, president	Gensia Pharmaceuticals, president (current)

CONTRACTS AWARDED

AWARDED TO	AWARDED BY	AMOUNT	PURPOSE
Adobe Systems 8ax 7900 Mountain View, CA 94039 (415) 961-4400	Fujitsu	Not disclosed	To license Adobe's PostScript interpreter software for Japanese and Western languages.
Adobe Systems 8ax 7900 Mountain View, CA 94039 (415) 961-4400	NEC	Not disclosed	To license Adobe's Kanji PostScript interpreter software.
Apollo Computer 330 Billerica Rd. Chelmsford, MA 01824 (617) 256-6600	Lockheed Missiles and Space	\$6-\$10 million subcontract	To supply workstations and other Apollo software and hardware products under Lockheed's Space Station Software Support Environment contract with NASA.
Apollo Computer 330 Billerica Rd. Chelmsford, MA 01824 (617) 256-6600	LTX	\$6 million	To buy and resell workstations and servers as part of LTX's Hi.T series of linear integrated-circuit testers and Trillium digital testers.
Applied Data Research Services 800 Fallin Lane Vienna, VA 22180 (703) 281-2000	U.S. Customs Service	\$2.1 million	To provide database and systems-support services at U.S. Customs computer sites.
Arvin/Calspan 4455 Gennseee St. Buffalo, NY 14226 (716) 632-7500	NASA, Ames Research Center	\$43.2 million	To operate, maintain, repair, and provide engineering support for the center's aerodynamic test, calibration, and support facilities.
Battelle, Columbus Div. 505 King Ave. Columbus, OH 43201 (614) 424-7984	Gas Research Institute	\$7.1 million	To continue development of an internal-combustion-engine heat pump for household use.
Bechtel Group 8ax 3965 San Francisco, CA 94131 (415) 768-6050	Defense Nuclear Agency	\$13.8 million	To develop the first phase of the Superconducting Magnetic Energy Storage Engineering Test Model, an attempt to use magnetic energy to power ground-based lasers for the Strategic Defense Initiative.
Celltech 6010 Sanoma Rd. Bethesda, MD 20817 (301) 493-5139	Ortho Pharmaceuticals	Not disclosed	To lease facilities and provide manpower for Ortho Pharmaceutical's subsidiary Ortho-Celltech Ltd., which will manufacture erythropoietin (EPO), a drug used to treat kidney failure.
Circorp/Aerospace Systems 1140 Gervais Ave. Maplewood, MN 55109 (612) 482-9655	LTV Aircraft Products Group	\$2.6 million	To provide four robotic systems for LTV's Flexible Composites Center, which will produce large, cured composite parts with complex geometries.
Computerbase International 7 Studebaker Irvine, CA 92718 (714) 855-9554	U.S. Air Force	\$8 million	To provide an advanced computer-language system.
Computer Consoles 97 Humboldt St. Rochester, NY 14609 (716) 482-5000	Bell Canada	Not disclosed	To provide Listing Services Database products, which connect to digital automatic call distributors.
Contel Federal Systems 12015 Lee Jackson Hwy. Fairfax, VA 22033 (703) 359-7500	North Atlantic Treaty Organization (NATO)	\$10.5 million	To design and implement a multilevel, secure command and control information system.

■ MARKET WATCH ■

AWARDED TO	AWARDED BY	AMOUNT	PURPOSE
Contel Federal Systems 12015 Lee Jackson Hwy. Fairfax, VA 22033 (703) 359-7500	U.S. Air Force	\$10.2 million	To design wideband communications to link the Air Force's Consolidated Space Operations Center with the Satellite Test Center and tracking stations worldwide.
Contel Federal Systems 12015 Lee Jackson Hwy. Fairfax, VA 22033 (703) 359-7500	Malmstrom Air Force Base, Great Falls, Montana	\$9.8 million	To upgrade the base's telecommunications system.
Data Group 77 S. Bedford St. Burlington, MA 01803 (617) 272-4100	TRW, Customer Service Division	Not disclosed	To buy Fieldwatch, an information-management system for organizations that service commercial and industrial equipment.
Delphos Systems 35 Pacella Park Dr. Randolph, MA 02368 (617) 961-2312	Unisys	\$50 million	To supply fax printers and components, plus associated services.
Harris Box 430 Melbourne, FL 32902 (305) 242-5462	Memphis Light, Gas and Water Division, Tennessee	\$2.1 million	To create a system for centralized control of electricity, gas, and water distribution.
Horshaw/Filtral 30100 Chagrin Blvd. Cleveland, OH 44124 (216) 292-9237	Martin Marietta Energy Systems	\$728,000	To supply a radiation-exposure monitor for employees at Martin Marietta's Oak Ridge National Laboratories.
Helix Software 83-65 Daniels St. Briarwood, NY 11435 (718) 262-8787	Wang Laboratories	Not disclosed	To package Helix's Pop-Up Genie desktop-organizer software for Wang laptop computers.
Lockheed Aeronautical Systems 86 S. Cobb Dr. Marietta, GA 30063 (404) 424-2701	U.S. Air Force, Aeronautical Systems Division	\$1.4 million	To design and demonstrate the use of machine intelligence in the cockpit of advanced fighter jets.
LTV Aircraft Products Box 655907 Dallas, TX 75265 (214) 266-5703	Canadair	\$10 million	To continue to provide engine housings for Challenger 601-3A executive business jets.
Metric Constructors 6060 Soint Albans St. Charlotte, NC 28287 (704) 553-3000	Greenville Storage and Investment	\$21 million	To construct a distribution center in Palmetto, Georgia, for the General Services Administration.
Microtel 7100 W. Comino Real Boca Raton, FL 33433 (800) 432-5043	State of Florida	\$5 million	To provide intrastate digital private line and WATS services for the state's SunCam telecommunications network.
Northern Telecom 200 Athens Way Nashville, TN 37228 (615) 734-4576	New York Hospital, Cornell Medical Center	\$6.6 million	To provide a PABX telephone network consisting of one Meridian SL-100 and two Meridian SL-1 Integrated Services Network systems.
RCA Aerospace & Defense Route 38, Bldg. 2061 Cherry Hill, NJ 08358 (609) 486-6392	Geostar	\$100 million	To provide location-finding communications satellites.
Robotic Vision Systems 425 Rabro Dr. East Hempstead, NY 11788 (516) 273-9700	General Motors	\$3.5 million	To provide a vision-guided robotic sealant system for a GM automobile assembly plant.

■ MARKETWATCH ■

AWARDED TO	AWARDED BY	AMOUNT	PURPOSE
Singer SimuFlite Training Box 619119 Dallas/F.W. Airport, TX 75261 (214) 456-8000	U.S. Navy	\$11.2 million	To provide simulator training for crews of the EA-6B Prowler, A-6E Intruder, and F/A-18 Hornet aircraft.
Spectrum Technology 6 October Hill Dr. Holliston, MA 01746 (617) 429-7050	U.S. Army Research Office	\$10.1 million	To develop the first artificial-intelligence processing of gallium arsenide for commercial production of semiconductors.
TRW Federal Systems Box 10400 Fairfax, VA 22031 (703) 734-6000	U.S. Navy	\$36.7 million	To begin upgrading the Anti-Submarine Warfare Operations Center for the Space & Naval Warfare Systems Command.

JOINT VENTURES

COMPANY	COMPANY	PURPOSE	CONTACT
Aer Lingus and TAP Air Portugal	Alitalia, Austrian Airlines, British Airways, British Caledonian, KLM, Swissair, and Covia	To add two companies to the seven already in Galileo, a consortium developing computer reservation and information systems for the airline industry.	Covia 9700 W. Higgins Rd. Rosemont, IL 60018 (312) 318-4000
Air Products & Chemicals	Arco Chemical	To develop polyalkylene-carbonate plastics for food containers.	Air Products & Chemicals 733 W. Broad St. Emmelle, PA 18049 (215) 481-6060
California Micro Devices	Telefonica	To design, build, and market application-specific integrated circuits, thin-film resistor networks, and nonimpact printhead substrates.	California Micro Devices 2000 W. 14th St. Tempe, AZ 85281 (602) 921-4552
Honeywell Bull	Groupe Bull	To conduct long-term research and development of computer products running under the Unix operating system.	Honeywell Bull 3800 W. 80th St. Minneapolis, MN 55431 (612) 896-3855
King's Medical	Wendt-Bristol	To form Bristol Diagnostics Services, which will provide magnetic-resonance imaging services to hospitals, clinics, and groups of private physicians.	Bristol Diagnostics Box 2158 Hudson, OH 44236 (800) 338-0691
McDonnell Douglas and Cadam	General Motors' Electronic Data Systems	To develop and implement a plan to standardize and enhance GM's computer-aided-design, manufacturing, and engineering systems.	McDonnell Douglas 325 McDonnell Blvd. St. Louis, MO 63042 (314) 232-3965
Northern Telecom	Compagnie Generale D'Industrie et de Participation and Banque Worms (France)	To design, manufacture, and sell advanced business-communications systems in France and other countries.	Northern Telecom 200 Athens Way Nashville, TN 37212 (615) 734-4000
Philips N.V.	Picker International	To form Philips and Picker Medical Systems, which becomes one of the world's largest producers of medical imaging equipment.	Hill and Knowlton 420 Lexington Ave. New York, NY 10017 (212) 697-5600
Sandoz	Repligen	To develop industrial and agricultural products by using biotechnology; also to develop proteins and enzymes for paper, textiles, and wastewater treatment.	Sandoz 4000 Monroe Ave. Charlotte, NC 28205 (704) 331-7000
Singapore Technology	Sierra Semiconductor and National Semiconductor	To form Chartered Semiconductor Ltd. in Singapore to build very-large-scale integrated circuits.	Sierra Semiconductor 2075 N. Capitol Ave. San Jose, CA 95132 (408) 263-9300

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The Senate intelligence committee has requested the panel's probe into the White House affair. The 7-6 vote in the panel reflected its desire to wait until new select committees inquire (Story on Page C)

Emergency workers 1 were killed and 176 injured when an Amtrak passenger train collided with Conrail freight locomotives. Federal investigators, saying it was too early to determine the cause, intensified their probe of the accident, focusing on possible human error or equipment failure. (Story on Page 16)

surroundings of debtors' prisons more than two centuries ago, but now it is arguably the game of the world's elite.

The domain of racquets once was as wide as the British Empire. But now the game is so obscure that it is played by only 200 or so in North America and by an additional 1,500 in British "public" schools and private clubs. The secret formula for constructing courts was buried with one family long ago, and the sole supplier of the

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MERGERS

COMPANY	BUSINESS	COMPANY	BUSINESS	NEW NAME
Informix Software 4100 Bahanna Dr. Menlo Park, CA 94025 (415) 322-4100	Supplies database-management and application-building software	Innovative Software 9B75 Widmer Rd. Lenexa, KS 66215 (913) 492-3800	Develops, markets, and supports business-application software	Innovative becomes a wholly-owned subsidiary of Informix but retains its name
Micro-MRP 1065 E. Hillsdale Blvd. Foster City, CA 94404 (415) 345-6000	Supplies microcomputer-based manufacturing and financial control software	ASA International 10 Monar Parkway Salem, NH 03079 (603) 898-7000	Designs, develops, markets, and supports business software based mainly on DEC hardware	Micro-MRP/ASA

ACQUISITIONS

BUYER	BUSINESS	COMPANY ACQUIRED	BUSINESS	AMOUNT
Air Products and Chemicals Allentown, PA 18195 (215) 481-4346	Supplies industrial gases, chemicals, and equipment	Anchor Chemical Group Manchester, England (215) 481-4346	Makes epoxy curing agents	\$45 million
Amtech Systems 131 S. Clark Tempe, AZ 85281 (602) 967-5146	Manufactures automated processing systems for semiconductor makers	RTS B102 E. McDowell Rd. Scottsdale, AZ 85257 (602) 941-0128	Supplies technical temporary employees for aerospace, defense, and computer companies	About \$675,000
Interspec 1100 E. Hector St. Canonsburg, PA 15428 (215) 834-1511	Develops, manufactures, markets, and services medical ultrasound and related products	Vimed Sound Box 141,3191 Harten, Norway 70-011-473342132	Develops and markets diagnostic ultrasound systems	Not disclosed
Memorex 461 S. Milpitas Blvd. Milpitas, CA 95035 (408) 957-1000	Manufactures personal computers, terminals, peripherals, and storage products	Telex 6422 East 41st St. Tulsa, OK 74135 (918) 627-1111	Manufactures IBM-compatible terminals, controllers, printers, tape drives, and PBX equipment	\$911.4 million
Olin Box 1355 Stamford, CT 06904 (203) 356-2000	Makes chemicals and metals; also involved in applied physics, electronic materials, and services	Aegis 50 Welby Rd. New Bedford, MA 02745 (617) 998-3141	Supplies custom and semicustom metal packages for hybrid integrated circuits	Not disclosed
Omega Technical 330 S. Executive Dr. Brookfield, WI 53005 (414) 784-7410	Provides temporary engineering and technical assistance to manufacturers	P&H Computer Graphics 315 W. Forest Hill Ave. Milwaukee, WI 53154 (414) 671-4400	Provides computer-aided-design services	Not disclosed
PDA Engineering 2975 Redhill Ave. Costa Mesa, CA 92626 (714) 540-B900	Designs, develops, and markets mechanical-engineering software	Numerics 3150 Livernois Rd. Tray, MI 48083 (313) 528-2080	Provides consulting services to the auto industry, including materials analysis and software development	\$1.5 million
Sequoia 200 Park Ave. New York, NY 10166 (212) 986-5500	Aerospace and military electronics	Atlantic Research 5390 Cherokee Ave. Alexandria, VA 22312 (703) 642-4000	Develops and builds rocket-propulsion equipment and data-communications testers	\$316 million
Taylor-Winfield 1052 Mohawk Ave. N.W. Worren, OH 44482 (216) 399-BB61	Manufactures automated metalworking and assembly systems	Accum-Motic Systems 11973 Mayfield Livonia, MI 48150 (313) 261-8060	Designs and manufactures automatic parts-handling systems	Not disclosed
Western Digital 2445 McCabe Way Irvine, CA 92714 (714) 863-0102	Makes storage-management, communications, and other processing products	Tandon's Winchester drive business 20320 Prairie St. Chatsworth, CA 91311 (818) 993-6644	Designs and builds Winchester random-access disk drives	\$40-\$45 million

RESEARCH REPORTS

STUDY BY	TITLE	FORECAST	PRICE
Biomedical Business Intl. 17722 Irvine Blvd. Tustin, CA 92680 (714) B38-8350	Market for Cancer Products and Services (#7077)	Reviews the growth in the market for cancer products and services stemming from developments in therapies, prevention, screening, and tests.	\$2,900
Business Communications 25 Van Zant St. Norwalk, CT 06855 (203) 853-4266	Chemicals for the Detergent Industry (#C-090)	This \$2.6-billion market will increase 7.2 percent annually, with the fastest growth in enzymes, especially proteases, which are expected to reach \$30 million by 1992.	\$1,950
Business Communications 25 Van Zant St. Norwalk, CT 06855 (203) 853-4266	The Changing Software Market (#G-032R)	The market will show developments in specialized and office-automation software, and will grow to \$22 billion by 1991 and to \$2B billion by 1996.	\$1,750
Epoch 5 Marketing 7 High St. Huntington, NY 11743 (516) 427-1713	The Patient-Controlled Analgesia Market	This market for pain relief could reach \$100 million per year. The report provides long-range information such as product life span, competition, and best time of market entry.	\$5,500
Frost & Sullivan 106 Fulton St. New York, NY 10038 (212) 233-1080	The Connector Market in the U.S. (#A1837)	The market will be stable through 1991, rising 7.7 percent annually to \$6.4 billion, with strongest gains in telecommunications and computer peripherals.	\$1,950
Frost & Sullivan 106 Fulton St. New York, NY 10038 (212) 233-1080	The Videodisc Market in Europe (#E870)	The market for industrial, institutional, and commercial videodisc systems may increase 25 percent annually through 1991, with \$350 million worth of machines installed by then.	\$2,500
Frost & Sullivan 106 Fulton St. New York, NY 10038 (212) 233-1080	Data and Voice Remote-Testing Equipment (#A1805)	The market will reach \$275 million in 1988, growing about 23 percent annually to reach \$495 million by 1991. Opportunities exist mainly in the general business end-user sector.	\$2,000
Frost & Sullivan 106 Fulton St. New York, NY 10038 (212) 233-1080	The U.S. Market for Intelligent Communications Processors (#A1649)	Data processing and communications will become a \$23.3-billion industry by 1992.	\$1,950
Input 1280 Villa St. Mountain View, CA 94041 (415) 961-3300	DEC vs. IBM, 1987-1992	The technology of IBM and DEC will coexist over the next five years. The report traces the history and recent strategies of the companies and projects strategies for the next five years.	\$995
Kessler Marketing Intelligence 31 Bridge St. Newport, RI 02840 (401) 849-6771	Markets for Medical Fiber-Optics: Laser Systems, Endoscope Systems, Sensor Systems, and Medical Fiber	Worldwide markets for medical fiber-optic systems will reach \$6 billion by 1995; worldwide markets for optical fibers in medicine will reach \$732 million in 1995.	\$2,750
Killen & Associates 482 Fulton St. Palo Alto, CA 94301 (415) 323-3842	IBM's Distributed-Database Strategy: Impacts and Opportunities	IBM will increasingly focus on distributed databases to ensnare competitive hardware and software systems in a web of systems software.	\$4,950
Kline & Company 330 Passaic Ave. Fairfield, NJ 07006 (201) 227-0882	Advanced Materials Technologies—Electronic Ceramics	The \$4-billion worldwide market will grow 14 percent annually through 1997.	\$6,500
Kline & Company 330 Passaic Ave. Fairfield, NJ 07006 (201) 227-0882	Additives and Processing Aids for Technical Ceramics	The market for technical ceramics will increase to \$12.9 billion in 1995, growing 10 percent annually as developments in ceramic processing create demands for new additives.	\$9,500

■ MARKETWATCH ■

STUDY BY	TITLE	FORECAST	PRICE
Link Resources 79 Fifth Ave. New York, NY 10003 (212) 627-1500	Voice Applications for Transaction Services	As voice equipment becomes a way to access databases, voice applications will expand to include customer service, telemarketing, and credit-card authorization.	\$1,495
Link Resources 79 Fifth Ave. New York, NY 10003 (212) 627-1500	Transactional Networks for Retail Card Systems	National and regional automatic-teller-machine networks, interbank networks, and international funds-transfer networks will increase as a way to expand bank markets.	\$1,495
Market Intelligence Research 2525 Charleston Rd. Mountain View, CA 94043 (415) 961-9000	Changing Structure in the Personal-Computer Market Through 1993 (# A270)	The personal-computer industry is driven by opposing forces of technological inertia and innovation. Issues include standards, open architecture, and modular designs.	\$995
Market Intelligence Research 2525 Charleston Rd. Mountain View, CA 94043 (415) 961-9000	Clinical Laboratory Instrumentation Markets (# A178)	The market for such instruments will increase from \$304 million in 1986 to \$400 million in 1990, reaching \$465 million by 1993.	\$995
Market Intelligence Research 2525 Charleston Rd. Mountain View, CA 94043 (415) 961-9000	Microcomputer Business-Application Software Markets (# A225)	The \$3-billion 1986 market will top \$7.6 billion by 1993. The report includes competitive analysis and market shares of contenders.	\$995
Market Intelligence Research 2525 Charleston Rd. Mountain View, CA 94043 (415) 961-9000	World Test and Measurement Markets II (# A251)	The market will reach \$13.9 billion in 1993, with U.S. sales accounting for 70 percent of the total.	\$995
Market Intelligence Research 2525 Charleston Rd. Mountain View, CA 94043 (415) 961-9000	Chemical and Gas Sensors Markets (# A217)	The 1986 market of \$2.1 million will grow to \$3.46 million by 1992. Covers 16 major chemical/gas sensor/analyzer markets, including chromatographs.	\$995
Market Intelligence Research 2525 Charleston Rd. Mountain View, CA 94043 (415) 961-9000	U.S. Markets for Standard and Special Machine Tools (# A117)	The rate of revenue growth for these tools will slow slightly, but the 1986 market of \$4.9 billion will reach \$5.68 billion in 1993.	\$995
Strategic Analysis 80x 3485, R.D. 3 Reading, PA 19606 (215) 779-9080	New Business Opportunities in Peptides	U.S. consumption of peptides will increase 10 percent each year, reaching \$4.4 billion by 1996.	\$17,500
Technical Insights 80x 1304 Fort Lee, NJ 07024 (201) 568-4744	Protein Engineering: Exploiting the Technology	Explains the dynamics of protein engineering, including information on companies developing products.	\$1,150
Technology Management Group 25 Science Park New Haven, CT 06511 (203) 786-5445	Growth Factors for Wound Healing—A Worldwide Study on Markets in Surgery, Eye Care, and Other Applications	Worldwide markets for genetically engineered skin-growth factor and related products will be significant by 1992, and should exceed \$7 billion by the late 1990s.	\$1,895
Theta Theta Building Middlefield, CT 06455 (203) 349-1054	Electrophoresis: Research & Clinical Markets (# 771)	Growth has been most rapid in the research and biotechnology electrophoresis markets; the research segment will reach \$170 million by 1990.	\$600
Theta Theta Building Middlefield, CT 06455 (203) 349-1054	Monoclonal Antibodies Markets (# 772)	Markets for drugs based on monoclonal antibodies will show high growth as applications expand. The \$250-million market will reach \$1 billion by 1991.	\$600
Theta Theta Building Middlefield, CT 06455 (203) 349-1054	Blood-Pressure Equipment Market (# 712)	The home market is expanding as health awareness increases. The report covers 15 manufacturers, plus the latest developments in instruments and accessories.	\$795

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Information Tools for Executives

DESKTOP

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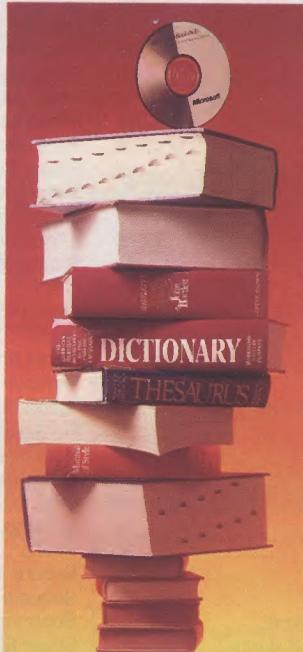
MICROSOFT'S Bookshelf software can help executives pack more punch into memos and letters. The product offers an exhaustive collection of popular reference books on one CD-ROM (compact disc, read-only memory), which works with a personal computer.

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about \$1,000, and MS-DOS CD-ROM extensions of 3.1 or higher. Bookshelf runs on an IBM PC/XT/AT or compatible computer with 640 kilobytes of random-access memory (512 kilobytes if the system has a hard disk).

Microsoft is located at 1601 Northeast 36th Way, Redmond, WA 98073. Telephone (206) 882-8080.

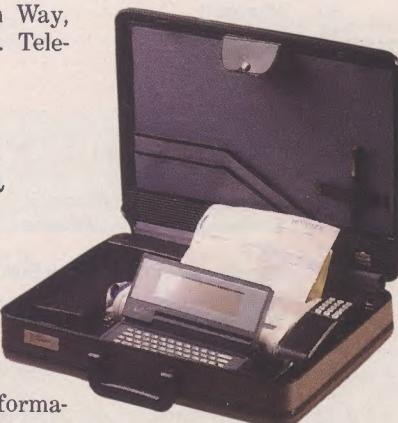
Computer system in a briefcase

NA CAR OR hotel room, at a client's office, or even on the sidewalk, business people can snatch information from their office computer with the Portable Cel-

lular Workstation. The 20-pound system comes in a briefcase for easy toting by brokers, salespeople, or technicians—anyone who needs access to information when away from the office.

The device, developed by Secure Technologies, combines a hand-held computer, a cellular telephone, an ink-jet printer, a 288-kilobyte processor with an RS-232C interface, and a Hayes-compatible cellular modem. Battery power lets the system send or receive data anywhere within a cellular telephone network. The workstation costs about \$5,000. Options include a barcode reader and a portable facsimile machine.

Secure Technologies advises rapid action for those interested in its product; supplies may become temporarily limited if the company lands an order being negotiated with the U.S. Departments of Agriculture, Environment, and Commerce. The company's address is 580 Herndon Parkway, Herndon, VA 22070. Telephone (703) 471-6338.



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OFFICE

Electronic greetings

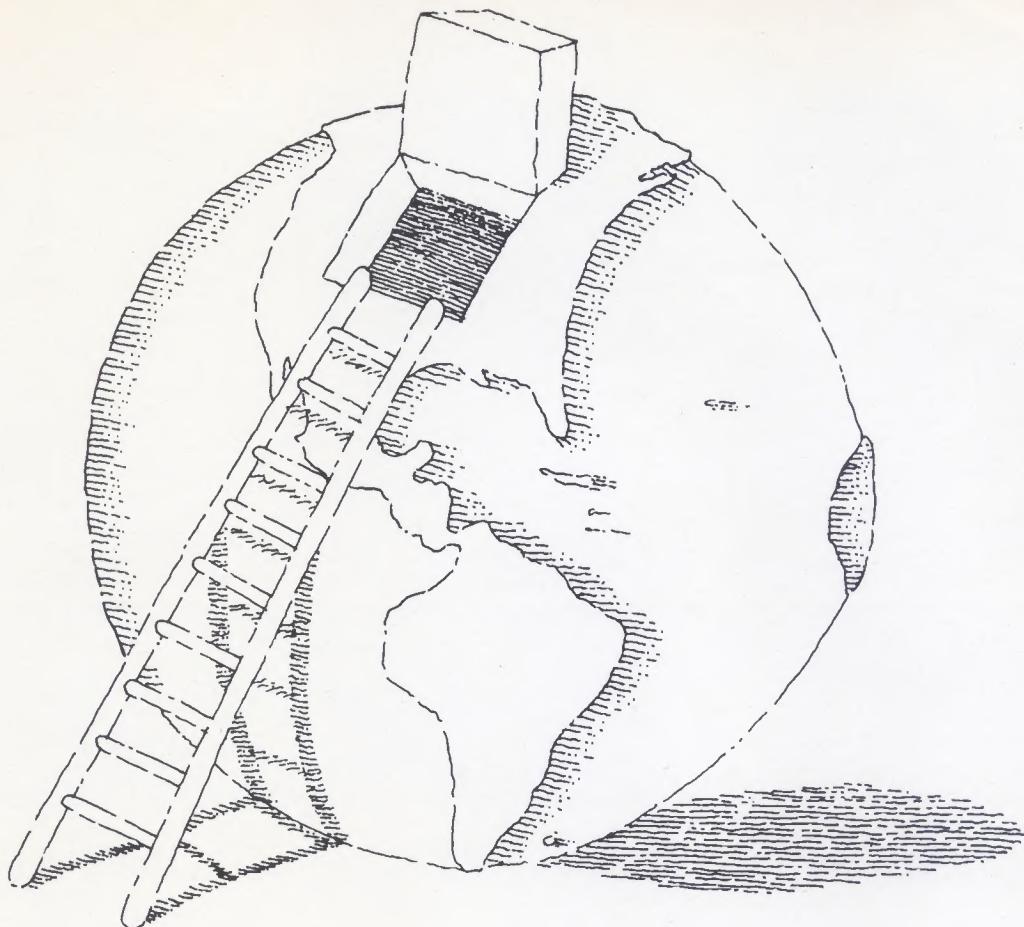
GREETING cards have joined the list of items that travel electronically. Businesses can send felicitations honoring a variety of occasions to 245 countries through the RCA Global Communications Group's telex service.

For between 65 cents and a dollar per minute, anyone with a telex machine or personal computer and modem can send a greeting on RCA's hotline. According to RCA, its greetings represent the only electronic-graphics transmission service that goes to such a large number of countries. The images can be sent to any business that subscribes to the telex service; the greetings arrive as printouts on a telex terminal. So far, electronic-mail services do not offer a comparable service that presents a graphic image on the recipient's computer screen.

The greeting cards celebrate many events, including U.S. and international holidays. Other offerings include birthday greetings, thank-you notes, and messages in various languages. Businesses can send cards with maps of major cities, zodiac symbols, and calendars, and RCA is now developing graphic messages connected with the upcoming Olympic Games.

For more information on the international telex service, call (800) 526-3969. ■

STEVEN MARK NEEDHAM



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